Vol. 4 MAY, 1922 No. 2

MAY 15 1922

THE PAPER INDUSTRY

The Monthly Educational Journal of the Paper Industry.

Paper *and* Pulp Mill Catalogue

ANSWERING former advertising, many paper and pulp manufacturers have written us to send copies of the Paper and Pulp Mill Catalogue to them. Some of them seem to think this big volume has already been issued. It will not be printed before Fall, as there are many months of hard work ahead to get it ready, but when it is, copies will be leased without cost to them, so that every manager and purchasing agent, general superintendent and chief engineer, chemist, and others will have copies. All of these manufacturers say it will be a wonderful help to them.

MACHINERY MANUFACTURERS AND DEALERS IN SUPPLIES

should get in touch with us immediately, so that every item that they have to sell to paper or pulp mills will be listed correctly. This is very important and should have immediate attention.

PAPER *and* PULP MILL CATALOGUE

356 Monadnock Building Chicago, Illinois

Nothing New Under the Sun

A familiar saying thrown
into the discard when
we designed our

New High Speed
Fourdrinier
Machine

Ask Us

The PUSEY and JONES COMPANY
Wilmington, Delaware
U. S. A.

V
4
1

THE MOORE & WHITE
Improved ROTARY SCREEN

Points of Superiority

Greater Capacity

Cleaner Stock

Lower Maintenance Cost

Fool-Proof

Compact

Reasonably Priced

Complete Information and Prices
Upon Request

THE MOORE & WHITE COMPANY

ESTABLISHED 1886

North Philadelphia Station, Penna. R. R., Philadelphia, U. S. A.

Vol. 4—No. 2

THE PAPER INDUSTRY

A. SCOTT DOWD
Editor

A MONTHLY EDUCATIONAL JOURNAL
Devoted to the Interests of the Pulp and Paper Industry

CONTENTS

FOR MAY, 1922

Editorials ..... 217, 221 and 225

A Method for the Determination of Soluble Sulphates as Sulphuric Acid in Waste Sulphite Liquor..... *E. C. Sherrard and G. W. Blanco* 241

Power Plant Management..... *Robert June, M.E.* 245

Log Barking ..... *W. H. Wharton* 248

Weights and Volumes of Pulp Stock..... *F. H. Shiland* 249

Steam Saving Effected by Soot Blower..... 250

Pointers for the Engineer..... *W. F. Shaphorst, M.E.* 251

The New Hinde & Dauch Mill..... 255

The Chemistry of the Sulphite Process..... *H. N. Miller and W. H. Swanson* 257

Some Factors Influencing Yield and Strength of Pulp Cooked by the Soda Process.... *Martin L. Griffin* 261

Recommended Specifications for Limestone and Lime in the Manufacture of Sulphite Pulp..... 269

Concerning the Analysis of the Raw Sulphite Acid..... *Dr. Rudolf Sieber* 271

Stamso-Cotton Linter Pulp..... *Stewart E. Seaman* 277

Concerning Lignin and Lignin Reactions..... *Dr. Peter Klason* 281

Report of the Committee on Sulphite Pulp..... *Carl Moe* 283

Report of the Committee on Bibliography..... *Clarence J. West* 285

Commercial Outlook 313

Domestic Markets 315

Current Quotations 321

Import and Export Markets..... 323

Buyers' Guide 329-333

Index to Advertisers..... 335

TERMS: To U. S., Alaska, Hawaii, Philippines, Porto Rico, Cuba and Mexico the subscription price is $2.00 per year. Canada, $2.50. Other countries, $3.00.

Entered as second-class matter February 13, 1920, at the postoffice at Chicago, Illinois, under the Act of March 3, 1879.

Copyright 1922 by

EDWARD B. FRITZ, Publisher

356 Monadnock Block Tel. Wabash 7327 Chicago, Ill., U. S. A.

Eastern Office: Room 1411-1412, 150 Nassau Street, New York City

Buy Your Paper Supply Now

THE volume of general business continues to expand; up-to-the-minute business statistics prove it beyond a shadow of a doubt. The steel business—always a reliable barometer of trade—has been operating at 75% of capacity, and advices from the East today state that the monthly announcement of the United States Steel Company's unfilled tonnage, due May 10th, will show a gain around 500,000 tons. This is tremendously impressive when it is borne in mind that the report also states that they are operating on a basis of 75% of present capacity—which is equal to 100% of capacity in pre-war days.

The last report from the Steel Company showed that they finished the month of March with an operation of 70% of capacity and predicted, before the unfilled tonnage report was given to the public, that their unfilled orders would show an increase of 150,000 tons—but when the report was actually received it showed that the were operating at the end of March at 70% and had gained in unfilled orders 335,000 tons.

We are wondering how long the pessimistic industrial and commercial bears will take, in the face of these indubitable evidences of progressive commercial prosperity, to shed their coats of fur, and acquire a coat of hair and a pair of horns.

Another magnificent evidence of the increased volume of general business is found in the car-loading reports, which showed a gain last week of 7,000 cars over any previous records this year, and this in spite of comparatively no movement of coal. Another tremendous factor is found in the increase in bank clearances all over the country, particularly here in Chicago, running some days as high as 30% over the clearances of the preceding week. Pick up almost any newspaper and turn to the market pages, and read the headlines in column after column, testifying to the fact that the textile business is gaining in volume and prices are rising—that the steel prices have advanced—that all stocks and bonds are not only strong but gaining each week in value—that the mail order houses are receiving greatly augmented orders from the farmers—that the foreigners are buying American wheat and farm products at remunerative figures to the American agriculturist—that the hide and leather trade had a magnificent business last week, and last, but not least, that all paper quotations have hardened perceptibly—that the declines in price have stopped, and that a large number of paper mills have actually advanced the price of their various products.

Add to these the fact that the stocks of paper in all positions, at the mills and in the hands of jobbers and consumers especially, are at the lowest ever known, conservatively estimated at 30% under the stocks in the hands of jobbers and consumers at this same date in 1919; and then figure, if you can, how we can avoid a coming period of congestion at the mills which will from now on be called upon to make rush shipments to supply large quantities of paper in a hurry because of this general revival of prosperous business.

The above are but a few of the various economic indices that show the trend of demand for commodities in America is substantially upward and continuing to grow in volume as the days go by, and all of which testifies to the fact that we are in for a period of higher prices.

Then read, mark and thoroughly digest the following, clipped from the Wall Street Journal of New York, April 20, 1922, "That another period of inflation with the cost of living soaring beyond the high peak of 1920 will afflict the United States within the next fourteen to sixteen months, unless we dispose of our surplus gold reserve, is the opinion of the best financial minds of Europe and America, according to Professor Harry A. E. Chandler, economist of the National Bank of Commerce in New York, who addressed the Bankers Forum today." That is to say that the enormous overstock of money and credit in the hands of the American bankers has been growing, and has grown to such an extent that it is becoming a liability on the bankers' hands, and must be put to work forthwith, and that in this endeavor to find employment for the tens of billions of available moneys and credits, industry and commerce will be stimulated probably beyond any other previous known record.

The time to buy commodities is when everybody wants to sell, and when deliveries can be consummated. The wise merchants and consumers will lay in their stocks of commodities, including paper, now and be prepared to sell them at advanced prices to the buyers who will be clamoring for them a few weeks or months hence.

One last, final thought before we leave the subject: The coal strike has been operative over forty days now. Fuel and power are two constituent factors in the production of fabricated articles. Without fuel and power factories cannot run. We had in stock sixty-three million tons above ground when the mines closed down. The rate at which we are using it is estimated at 8,400,000 tons of coal per week; the non-union mines are producing about 3,400,000 tons per week. We have, therefore, drawn down the coal supply in six weeks some 30,000,000 tons and have approximately 35,000,000 tons. Before July 1st, unless the strike is settled, there will be a wild scramble for coal, for all reserves will be cleaned up and non-union coal will rise, probably to unprecedented prices. That is worth thinking about! If the strike is settled by June 15th, it will mean we will have practically no reserves and with industry enlarging and no stock of coal ahead for the winter, the railroads will be commandeered for every empty car possible for the transportation of coal all over the United States in order to get a fraction of the winter's supply in ahead of the fall weather.

In any event we are facing a most serious situation and The Paper Industry again reiterates its advice, "Buy Your Paper Supply Now. Get in a good stock; pay the prices demanded to get quick shipments."

Long Life is Built Into ABC Vertical Engines

Compact and sturdy—demanding little attention—A B C Vertical Self-Oiling Engines are particularly adaptable for the operation of blowers, generators, pumps and other units.

It is not unusual for A B C Engines to operate continuously for a generation—and scores of engines are performing satisfactorily after having given reliable service for 10, 15 and 20 years.

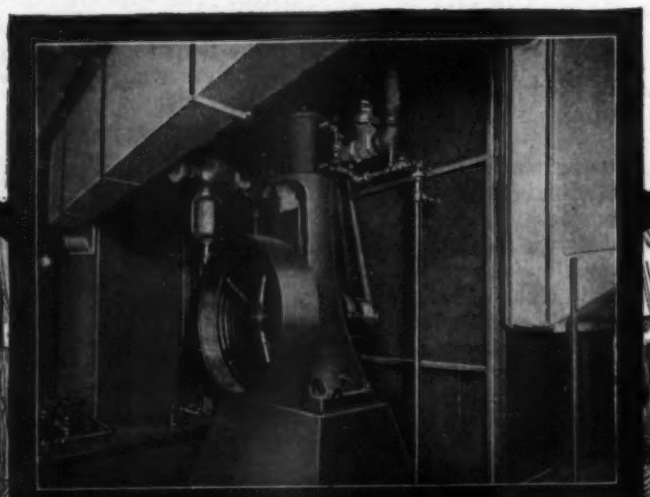
A B C Engines are economical and will save their original cost in a short time out of the difference in the cost of operation as compared to ordinary horizontal steam engines.

The automatic oiling system reduces the consumption of oil to only about one-fifth of the usual amount.

We will gladly send you complete information regarding A B C Engines and will refer you to plants in your locality where these units have given never-faltering, economical service over a long period of years.

AMERICAN BLOWER COMPANY, DETROIT
BRANCH OFFICES IN ALL PRINCIPAL CITIES
CANADIAN SIROCCO COMPANY, LIMITED, WINDSOR, ONTARIO

(84)



"Sirocco" Products

BLOWERS • EXHAUSTERS • VENTILATING FANS • AIR WASHERS • ENGINES

FOR HEATING, VENTILATING, DRYING, AIR CONDITIONING, MECHANICAL DRAFT

Drones Not Wanted

SOME days ago I met two men, one in the morning and the other in the afternoon. Both had been employees of the same place. Both of them had fallen down considerably in the business they had produced in the past few months, and the boss had called them both on the carpet, and told them, at different times, that he felt he would have to get along without them. He told them he had the kindest of feelings for them, and regretted to have to turn them loose, but that it was a business proposition, that he was in his position to produce, and he and the men under him had to do so.

One of these men resented the remarks about his ability or seeming lack of it to produce, and told the boss some things he thought he ought to say. He is still out of a job.

The other man gritted his teeth to keep back what he might have said, but he realized the firm could not pay him unless he produced. He put on his coat and hat and went out into the air to think it over, for he was very much in need of the weekly salary that he had been drawing. Instead of finding fault with his employer, he searched himself to see where the trouble was. He realized that he was not producing, but he believed he could, and though he had been told to look for another job, he again gritted his teeth and started at it, and in the next few days produced more business than he had for a long time.

He then laid his cards on the table for the boss to see, and this man said to him: "I am pleased at what you have been able to do. I was pleased at the way you acted when I told you to look for another job. Mr. —— might have done the same thing that you did, but instead he said some unpleasant things, and now is out of a job."

It pays to buckle down to your job and produce. These are not times when employers can afford to keep non-producers. Whether you call yours a job or a position, it is the best thing you can have at this time. The streets are full of idle men and most of them would be tickled to get what you are getting.

If you hear the management—and by the way the management has its troubles—talking about cutting wages, step on it. Speed up. Make yourself indispensable, but the only way to do that is to obey orders and produce. Face your present job or position as the biggest thing in life to you, and as your opportunity for the future, for unless you produce now you may not do so at any other time, and then you are lost. Your pay may not be enough in your opinion, but it is opinion of the boss that counts, for if you are earning much more than you are getting or more than some other man could, he will not let you go, and it is only by earning more than you are now getting that can possibly be an incentive for the boss to give you more than you are now receiving.

Your job and your future are in your own hands.

Community House
Parchmentville, Kalamazoo, Mich.

Architects & Engineers
Billingham & Cobb, Kalamazoo, Mich.

DREAMING and planning for something more than just a mill, where men worked, where paper was made and where profits might accrue, the founders of the Kalamazoo Vegetable Parchment Co. conceived Parchmentville—the community of workers. In Parchmentville live those who toil in the big KVP mill—mill hands and executives having many common interests, regardless of title or size of pay check. The beautiful Community House, just completed, will afford them an opportunity for "getting together," for profitable instruction and good, wholesome entertainment. A place, where all may meet upon an equality; and where, one may enjoy the companionship and fellowship of the others.

Commendable in appearance is this Community House and it has a number of excellent features, the cafeteria, a complete motion picture outfit, and a properly designed and well functioning heating and ventilating system. A Clarage Kalamazoo Multiblade Fan was selected for the heating and ventilating, not because of lower price, but because of the dependability of Clarage equipment and the hearty cooperation of Clarage engineers.

Aside from strictly heating and ventilating work, Clarage Fans have many uses in a paper mill. If your problem is roof drying, moisture absorption, paper stock conveying, calender roll cooling or mechanical draft, write for our literature today.

CLARAGE FAN COMPANY
Main Office and Factory, KALAMAZOO, MICHIGAN

Cafeteria in the Basement

Auditorium from Entrances at Rear

CLARAGE — KALAMAZOO Multiblade Fans

Business Sense

By IKE KENNEDY

Work

IF YOU want to know the blessings of being on the job just try resting awhile! If you have never indulged in the experience of a padded cell just try loafing, you'll get the same effects. The hardest job in all the world is idleness. Some of you won't believe that; a lot of us would love to live and sing the song,

I would I were a little rock
A sitting on a hill,
And doing nothin' all day long
But just a sittin' still.
I wouldn't eat, I wouldn't drink,
I wouldn't even wash,
I'd sit and sit a thousand years
And rest myself by gosh.

And how we abuse the blessed privilege of work, the God-sent opportunity of doing well the task at hand.

How some of us get by with our assignments is a mystery. We are abusers of privilege, construing tolerance for license, and kindness for indulgence. We are drifters with the tide, yet wonder how the live trout ascend the streams. We imagine we are working, not through choice, or love of work, but through the actual necessity of it. You were never farther from the truth in your life. The idle house of any penal institution is the greatest harrow, the greatest punishment, next to the wheel, ever inflicted on human beings. The stone pile is a joy ride in comparison.

It's too bad that the whole world can't be thrust into abject idleness for about thirty days—too bad that every holdover who has sailed along so smoothly and indifferently through these trying times, could not have had a taste from the bitter cup of idleness. It would put more of the real spirit of accomplishment into our affairs than all the puffing, bolstering essays of the optimist ever written.

Were you ever once hungry enough to envy the workingman the contents of his dinner pail? If you ever were, you will love your job for-ever more, and you never will love it until your tired body and distressed mind have been broken on the rack of adversity.

We seem to have lost the invigorating relaxation of tired minds and tired bodies. The pressure seems to be off at the power plant of our great resourcefulness. We seem to lack the impelling force of appreciation of our greatest blessing. We are not progressing as we should and cannot until we actually produce to the point of sufficiency, only to find that "enough is not sufficient."

Radio

WITHOUT knowing the first thing about it, there is nevertheless "an awe-inspiring something" about this new field of discovery, as fascinating and alluring as the gold discovery of '49. The gold which will be taken out of this new industry will pale into insignificance anything hitherto dreamed of in the line of mechanical invention. When it is taken into consideration that at one period before 1914 the sale of Phonographs and their accessories exceeded by $84,000,000 the entire cotton crop valuation of the U. S. for the same period, one may get some estimate of the magnitude of the great development of this new Aladdin's Lamp, which, but to touch, has already started the wheels of industry in a mad whirl for dominant supremacy. It is not too much to say that Radio has passed over right from a faddish toy to a reality of accomplished miracles. When Morse flashed his appreciation of his first message from Baltimore over his great invention which revolutionized the world of commerce in dots and dashes of his invention of the Telegraph instrument, he thought he was doing something, and he really did something so big that it has taken us not far from a century to overcome his lead.

When Alexander Graham Bell transmitted the human voice over wires, he gave us what we considered about the omega of all accomplishment in this endeavor.

When Thomas Edison chiseled the wave sounds of the human voice into an eternal record, when the divine voices of this generation may sing on for centuries to come, and caused to move with animation those things recorded through the camera's eye and gave us moving pictures, he started something, the end and far-reaching beneficial effects of which will outlive the youngest of us. But here is a weird, uncanny, intangible something with the wings of Mercury at our beck and call, a willing slave, an obedient messenger which speaks with a voice from the depths to the high heaven. An Aerial and a Receiver and the secret places are laid bare. The occident can lean over the back fence for a bit of gossip with the orient; Mrs. Ah Sin can converse with Mrs. Abdul Hammad without toll or ransom. The human element is almost entirely eliminated, simply twist its tail and catch King George in one of his conversational moods and the whole world is akin and on speaking terms.

The Morse instrument gave us our first contact; register second for the Telephone; put Air Brakes third; Phonograph fourth; Flying Machines fifth; Movies sixth and the Radio seventh. It is the forerunner of the greatest era this world has ever known.

LINING THINGS UP

are the functions of our

Sheet or Web Liners

These are made for Single, Double and SPECIAL DUTIES.

When you have a LINING PROBLEM get off a 'line' to

BELOIT

Beloit Iron Works, Beloit, Wis., U. S. A.

A Method for the Determination of Soluble Sulphates as Sulphuric Acid in Waste Sulphite Liquor

By E. C. SHERRARD and G. W. BLANCO, Chemist and Assistant Chemist in Forest Products

Forest Products Laboratory, Madison, Wis.

EXPERIMENTS carried out at the Forest Products Laboratory on the fermentation of waste sulphite liquor[1] showed marked variation in the sugar content of the various samples fermented. It was pointed out that the cause of these fluctuations of sugar yield was possibly the presence of sulphuric acid in the liquor. As a matter of fact, the liquor always contains small quantities of sulphuric acid, partly as free sulphuric acid and partly as soluble sulphates, together with small quantities of acetic, formic, oxalic, and traces of citric acid.[2] In order to continue the investigation upon the preparation of alcohol from waste sulphite liquor, particularly as regards sugar production, the necessity of determining accurately the exact amount of sulphuric acid in these liquors became self evident, and an investigation was started with this purpose in view.

The quantitative determination of sulphates does not seem to have especially attracted the attention of the numerous investigators of problems dealing with sulphite liquors. Although the literature in this field is very extensive, touching practically all the phases and uses of waste sulphite liquor, little information is to be found regarding the quantitative estimation of this constituent. Von Possauner and R. Dittrich,[3] in a paper dealing with the detection and separation of the different sulphur compounds in calcium sulphite liquor, recommend heating the waste liquor with hydrochloric acid in a current of carbon dioxide until all the sulphur dioxide is expelled, and then precipitating the sulphuric acid with barium chloride.

In the determination of sulphuric acid in wine, Von der Heide[4] boiled 100 cc of water and 10 cc of 10 per cent HCl in a 500 cc flask, passing in CO_2 to displace the air. To this boiling solution he added 100 cc of fresh wine and continued boiling for ½ hour, after which period the mixture was concentrated to 100 cc, diluted to 150 cc, and precipitated with $BaCl_2$ in the usual manner.

Considerable attention has, however, been devoted to the determination of sulphurous acid in sulphite liquor. In the determination of sulphuric acid, we are interested in a method whereby all of the free and loosely fixed SO_2 is most rapidly driven off in order to prevent its oxidation to SO_3 and thus avoid obtaining results higher than the actual amount of sulphates present. A. Stutzer[5] proposes distillation with acetic acid and CO_2, thus decomposing the inorganic sulphites but attacking the sulphurous acid in combination with aldehydes and lignin only to a slight extent. The same author[6] used formaldehyde to remove the SO_2 in cases where sulphite liquors were to be used as feeding stuff, since by this treatment the content of sulphurous acid is very much reduced. This is best done by the addition of a small excess of calcium carbonate, thus converting the sulphurous acid into calcium bisulphite, the latter combining with the formaldehyde.

Apparently calcium carbonate and lime remove only a very small portion of the sulphurous acid in the form of calcium monosulphite. In the case of lime and the fixed alkalies, an abnormally large quantity is required to neutralize the liquors, owing to their action on the carbohydrates present, forming acid bodies presumably saccharides.[7] However, ammonia does not seem to exercise such an action. Stutzer[8] also removes the sulphurous acid by making the hot waste liquor alkaline with ammonium hydroxide or ammonium carbonate. The liquid is filtered after a time or otherwise clarified and evaporated to a sirupy or solid mass.

As will be seen later these methods of removing sulphurous acid from waste liquors are not altogether adequate in the determination of sulphates, especially where a short method is desired. The acetic acid method proved to be the most satisfactory of the procedures suggested by Stutzer.

The apparatus used to carry out the present investigation is shown in the accompanying figure. It consists of a Kipp generator containing marble and dilute hydrochloric acid to generate carbon dioxide; a wash bottle with water; a glass Y-shaped tube con-

[1] "Ethyl Alcohol from Waste Sulphite Liquor," by Sherrard and Blanco, Paper, July 2, 1919.

[2] Forestry Branch of Canada, Bul. 66, p. 14.

[3] Jour. Soc. Chem. Ind., 1912, p. 583.

[4] Zeits. f. Anal. Chem., 1913, p. 440.

[5] Jour. Soc. Chem. Ind., Vol. 29, (1919) p. 1370; Chem. Ztg., Vol. 34 (1910) p. 1167.

[6] Jour. Soc. Chem. Ind., Vol. 28, (1909) p. 1162.

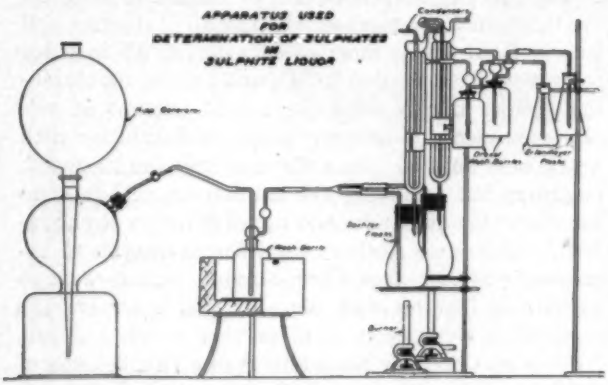
[7] Chem. Abstracts, Vol. 4, (1910) p. 107.

[8] Chem. Abstracts, Vol. 5, (1911) p. 3622.

nected to bent glass tubes leading to the bottom of Soxhlet flasks, which are provided with condensers. The ends of the delivery glass tubes immersed in the liquor are drawn to a small orifice. The Drexel wash bottles contain iodine solution of a given strength, and the Erlenmeyer flasks contain a measured amount of standard sodium thiosulphate solution for the absorption of any vapors which might escape during the experiment.

Method Used for Sulphate Determination

In 250 Soxhlet flasks are placed about 55 cc of distilled water and 25 cc of 25 per cent hydrochloric



acid (approximately equivalent to 16 cc of ordinary concentrated acid). The flasks are clamped in position under the condensers and 25 cc of waste sulphite liquor, or raw sulphite acid, as the case may be, are pipetted into the two Soxhlet flasks, the second being corked immediately and connected to the generator. The condenser stoppers are coated with collodion in order to insure tight connections. The flasks containing the iodine solution and standard sodium thiosulphate are connected to the condenser outlet. Carbon dioxide is then passed through for about five minutes until all the air is displaced from the apparatus, thus obtaining an atmosphere of carbon dioxide in which very little or no oxidation of SO_2 to SO_3 takes place. At this stage the solutions in the Soxhlet flasks are slowly heated until they boil gently, and the boiling is continued until the experiment is finished. Any liquor vaporized during heating is condensed back into the flask, thus maintaining almost constant concentration of the solution. The SO_2 evolved is swept out by the carbon dioxide, is cooled on escaping, and is finally absorbed in the iodine solution. At the end of the experiment, the excess iodine is titrated with sodium thiosulphate of equivalent strength, using starch solution as an indicator. From the amount of iodine reduced by the evolved SO_2 the quantity of the latter is calculated. The end point of the reaction occurs when the iodine solution is no longer decolorized, or better still by bubbling the escaping gas through a very weak iodine solution in a pill plate in case that the amount of SO_2 given off is not being determined. Ordinarly it takes from 45 minutes to 1 hour to completely remove the SO_2, this time varying according to the amount of SO_2 present, the rate at which the CO_2 is passed through the solution, and also according to the rate of heating of the latter. When all the SO_2 is expelled, the Soxhlet flasks are disconnected and the sulphate free precipitate formed is filtered off. The filter is thoroughly washed with hot water, and the clear filtrate is neutralized with NH_4OH and made slightly acid with HCl. It is diluted to approximately 400 cc, brought to a boil and 10 cc of N/2 $BaCl_2$ are very slowly added. Boiling is continued until the $BaSO_4$ precipitated becomes granular and is then kept hot for from 4 to 6 hours longer. The $BaSO_4$ is then filtered and thoroughly washed with hot water until free from chloride. It is carefully ignited, allowed to cool, and then weighed.

Experimental

The results in Table I represent experiments carried out to ascertain whether an atmosphere of carbon dioxide is necessary and at the same time to establish an approximate relationship between the amounts of sulphates obtained with and without the use of carbon dioxide. In all of these experiments except No. 6, 50 cc of the liquor to be analyzed were used together with 50 cc of water and 5 cc of concentrated HCl.

In experiment 6, 10 cc of raw sulphite acid and 25 cc of concentrated HCl were boiled for 50 minutes to drive out the SO_2, and hot water was added from time to time to make up for evaporation. When no appreciable odor of SO_2 was detected, the solution was diluted to about 400 cc and the $BaSO_4$ determined as described. This procedure requires a fairly large amount of concentrated acid and the results are not easily duplicated. Sample I of experiment 2 was concentrated in the hope of precipitating any humus material present, but no precipitate was obtained. It was then diluted and precipitated with $BaCl_2$. Sample II was decolorized with tannic acid after passing CO_2 in order to precipitate albuminous material. After filtering it was diluted and precipitated as usual. As shown in Table I, the difference between these two procedures is well within the limits of error.

Experiment 3 gave a very satisfactory indication of the amount of SO_2 liberated during boiling with hydrochloric acid and carbon dioxide.

The main feature of Table I is the decided difference between the amounts of sulphuric acid found on treating the sample with CO_2 and without CO_2. Roughly the amount of sulphate and sulphuric acid obtained without using CO_2 is almost twice as large as when the same sample of raw acid or waste liquor is submitted to boiling with HCl in a current of CO_2. This is well illustrated in experiments 1 and 4, and it shows that a marked oxidation of SO_2 to SO_3 does take place on boiling the sulphite liquor with HCl in the presence of air.

The $BaSO_4$ precipitate obtained using 5 cc of con-

centrated HCl in the CO_2 treatment of waste liquor was generally impure, having in most cases a grayish white appearance. It was also observed that even after filtering several times, $BaSO_4$ would persistently precipitate out of the clear filtrate on standing. It was thought that perhaps the amount of HCl present was not sufficient to liberate at once all the loosely combined SO_2 and that on standing some of this retained SO_2 would be oxidized to SO_3 and precipitated out as $BaSO_4$. A more probable explanation is that the quantity of HCl present was not sufficient to completely hydrolyze all of the organic sulphonates in the period of time used and that a slow hydrolysis followed, with the subsequent precipitation of the sulphuric acid thus formed by the excess $BaCl_2$. In order to determine the conditions best suited for the precipitation, the experiments grouped in Table II were carried out on samples of the same waste liquor obtained from Sitka spruce, with the exception of experiments 5 and 6 in which waste liquor from western hemlock was used. The most satisfactory results were obtained by using 25 cc of 25 per cent HCl, taking about 45 minutes to expel the SO_2. The $BaSO_4$ precipitate is coarse, settles rapidly, filters easily, and is perfectly white on ignition. Moreover, no further precipitate forms in the $BaSO_4$ filtrate on standing, as is the case when either 5 cc or 10 cc of concentrated HCl is used.

Experiment 7, in which 10 per cent NH_4OH was used, gave results about twice as large as those obtained in experiment 2. Calcium bisulphite was precipitated and very little SO_2 was expelled; hence the results are practically the same as when the experiment is performed in the presence of air.

Heating the waste liquor with NH_4OH and with $(NH_4)_2CO_3$, respectively, under a reflux condenser gave unsatisfactory results. Ammonia if used in slight excess liberates some of the sulphurous acid in combination with the aldehydes, while the lignosulphonic acids are not decomposed. In order to remove the SO_2 with NH_4OH, the waste liquor should be evaporated to a syrup or to dryness.

Heating the waste liquor with anhydrous sodium carbonate did not give satisfactory results.

While the proposed method is satisfactory for the determination of soluble sulphates, it tells nothing as regards the condition of the sulphuric acid. In order to determine the effect of an excess of sulphuric acid on the sulphites contained in waste sulphite liquor, two simple experiments were carried out. Given

TABLE I

Exp. No.	Liquor	Wood	CO_2 Treatment Grs. SO_2/100 cc. Sample I	CO_2 Treatment Grs. SO_2/100 cc. Sample II	CO_2 Treatment Grs. H_2SO_4/100 cc. Sample I	CO_2 Treatment Grs. H_2SO_4/100 cc. Sample II	Without CO_2 Treatment Grs. SO_2/100 cc.	Without CO_2 Treatment Grs. H_2SO_4/100cc.	Ignited residue after CO_2 treatment. Grs/100 cc.
1	Raw acid		0.0352	0.0343	0.0431	0.0420	0.0651	0.0797	
2	Waste liquor		0.1196	0.1292	0.1465	0.1583			
3	Waste liquor	White oak	0.3036*	0.3267*					0.0062
4	Waste liquor	White oak	0.1538		0.1874		0.2928	0.3588	
5	Raw acid		0.0853	0.0841	0.1032	0.1031			
6	Raw acid						0.1111	0.1361	
7	Raw acid						0.7670	0.9530	
8	Waste liquor		0.2158	0.2333	0.2644	0.2858			
9	Raw acid		0.0664	0.0652	0.0814	0.0798			

* Grs. SO_2/100 cc.

TABLE II

CO Treatment

Exp. No.	No. of cc. of Waste Liquor	Acid CC.	No. of cc. of Water	Grs. SO_2/100 cc. Sample I	Grs. SO_2/100 cc. Sample II	Grs. H_2SO_4/100 cc. Sample I	Grs. H_2SO_4/100 cc. Sample II	Remarks
1	50	5 conc. HCl	50	0.1643	0.1617	0.2013	0.1981	Ignited $BaSO_4$ was grayish white. Filtrate from $BaSO_4$ deposited more $BaSO_4$ on standing which however was not recovered.
2	25	25 25% HCl	55	0.1915		0.2346		A good granular ppt. of $BaSO_4$ which filtered very easily.
3	25	25 25% acetic acid	55	0.1676	0.1730	0.2053	0.2119	The same observations as in Experiment I.
4	25	25 25% Phosphoric acid	55					A milky ppt. was obtained which at first ran through the filter and then was slow in filtering.
5	25	25 25% HCl	55	0.1389	0.1407	0.1702	0.1724	A dark brown ppt. was found on treating with CO_2, which on ignition left a residue weighing less than 5 mgs. Ignited $BaSO_4$ was white.
6	25	10 conc. HCl	70	0.1313	0.1325	0.1612	0.1623	The same observations as in Experiment I. Ignited $BaSO_4$ was white.
7	25	5 10% NH_4OH	75	0.4078	0.3812	0.4997	0.4671	

TABLE III

Carbon Dioxide Treatment

Exp. No.	No. of cc. Waste Liquor	No. of cc. of Acid	cc. Water	Gms. SO_2 Per 25 cc. Sample I	Gms. SO_2 Per 25 cc. Sample II	Gms. H_2SO_4 Per 25 cc. Sample I	Gms. H_2SO_4 Per 25 cc. Sample II
1	25	None	75	0.0377	0.0397	0.1412	0.1408
2	25	75 N/10 H_2SO_4	None	0.0468	0.0458	0.4989 (Total)	0.5036 (Total)
3	25	25 25% HCl	50	0.0498	0.0515	0.1442	0.1437

amounts of raw sulphite acid were titrated with N/10 NaOH and N/10 iodine solution respectively. To equal portions of raw acid was then added a volume of N/10 sulphuric acid equivalent to 0.36 per cent H_2SO_4 by weight. The mixtures were again titrated with N/10 NaOH and N/10 iodine solution, respectively. The alkali titration showed an increase in free acidity corresponding to the amount of N/10H_2SO_4 added, while the quantity of N/10 iodine required was increased about 0.2 cc. Twenty-five cc of sulphite acid and a mixture of 25 cc of sulphite acid and 75 cc of N/10H_2SO_4 were then each subjected to carbon dioxide treatment and the amount of sulphuric acid determined in both solutions. The total amount of sulphuric acid found in the second case minus the sulphuric acid present in 25 cc of the sulphite acid is equivalent to the quantity of sulphuric acid calculated to be present in 75 cc of N/10 H_2SO_4. The same treatment was applied to 25 cc of the blow-off waste sulphite liquor and a mixture of 25 cc of blow-off liquor and 75 cc N/10 sulphuric acid, respectively, giving results almost identical in relation to those obtained in the case of raw sulphite acid. Both experiments showed no oxidation of combined or free sulphurous acid.

These experiments indicate that a small portion of sulphites is decomposed with the formation of sulphurous acid, a reaction which would not be indicated by the titration with alkali, but which should be discernible in the iodine titration. The iodine titration indicates the loss of 0.00636 gm. SO_2 by the addition of 0.367 gm. sulphuric acid. Since not all of the SO_2 was displaced (ex. 3, Table III) by the addition of the excess H_2SO_4, the presence of other acids and salts must interefere with the reaction.

Waste liquor obtained from white spruce cooked with 1.24 combined acid was used for the experiments in Table III. The main purpose in performing these experiments was to find out to what extent sulphuric acid would react with the soluble sulphites in the liquor. The total amount of sulphuric acid in experiment 2 includes the quantity of H_2SO_4 in 75 cc of N/10 acid and in 25 cc of waste liquor. The amount of SO_2 evolved and the sulphuric acid in the treated liquors were determined according to the method outlined above.

Comparing experiments 1 and 2, it will be noted that in the latter case there is a slight increase in the amount of sulphur dioxide liberated. Assuming that sulphuric acid reacts in equimolecular proportion with soluble sulphites or acid sulphites and forms calcium or magnesium sulphate, these results indicate that it must be present in a very large excess in order to liberate all of the combined sulphur dioxide. To be more exact, when sulphuric acid is added to waste sulphite liquor one part of sulphur dioxide is liberated by 30.5 parts of acid. If we consider that the acid reacts quantatively with calcium or magnesium acid sulphite instead of the normal sulphites as above, then one part of sulphur dioxide is liberated by 61 parts of sulphuric acid. On the other hand, the results indicate that when approximately 200 parts of acid are added to sulphite liquor, 64.4 per cent of the combined sulphur dioxide is liberated and that the residual combined sulphur dioxide equivalent to 35.6 per cent of the total combined is retained even in the presence of approximately 500 parts of sulphuric acid.

It is realized that the results herein contained are open to question because of the extremely small quantities used and consequently the large error involved. They do, however, strengthen the theory that sulphuric acid can exist as such in appreciable quantity in waste sulphite liquor.

The results of experiments 1 and 3 might lead to the conclusion that CO_2 alone is as efficient as CO_2 and hydrochloric acid in removing sulphur dioxide, or rather in preventing its oxidation to SO_3, since in both cases the content of H_2SO_4 found agree very closely. But the $BaSO_4$ filtrate, in the case where CO_2 alone was used to expel the SO_2, persistently precipitated out on standing as a very fine precipitate which was difficult to filter. The quantity of barium sulphate thus formed was very small and no doubt accounts for the difference in results obtained in experiments 1 and 3. Using CO_2 and hydrochloric acid in experiment 3 the soluble sulphites or sulphonates are completely broken up and the precipitated $BaSO_4$ is easy to filter, giving a filtrate which remains clear indefinitely.

The preceding experiments and the fact that the raw sulphite acid as well as the waste sulphite liquor always show a decided acidity may indicate that the concentration of hydrogen ions present in these liquors is largely due to the presence of sulphuric acid. Because of the extreme complexity of waste sulphite liquor it is, of course, impossible to state exactly the concentration of sulphuric acid contained in it. The results, however, do give an idea as to the magnitude of this concentration. In mill practice the determination of soluble sulphates in waste sulphite liquors as indicated here might well be considered in terms of sulphuric acid.

Summary

(1) A rapid and accurate method for the determination of soluble sulphates in sulphite cooking acid or waste sulphite liquor has been described.

(2) The method affords the determination of the evolved SO_2 for comparative purposes or otherwise.

(3) Other possible reagents besides hydrochloric have been excluded.

(4) Dilute sulphuric acid reacts to a limited extent with dilute solutions of sulphites present in waste sulphite liquor but a part of the acidity is due to the presence of sulphuric acid as such.

Power Plant Management

Steam Turbine—Part 2

By ROBERT JUNE, Associate Member, A.S.M.E.

IT is not a very satisfactory proceeding to attempt a general classification of steam turbines because the various groups overlap to a considerable extent. However, there are sufficient differences in the characteristics of a number of well known turbines so that they may be conveniently classified according to the fundamental principles involved in their operation as follows:

Impulse				Reaction	Combined Impulse and Reaction
Single Velocity	Multi-Velocity Stage	Single Velocity Stage	Multi-Velocity Stage	Multi-Velocity Stage	Multi-Velocity Stage
DeLaval	Terry Sturtevant Curtis (Small Type) Westinghouse	Kerr DeLaval Rateau	Curtis	Westinghouse Parsons Allis-Chalmers Parsons	Westinghouse
Single Pressure Stage		Multi-Pressure Stage			

Impulse Turbines

In turbines of the impulse type the complete expansion takes place in the stationary blades or nozzles and the steam is delivered to the moving blades with a velocity somewhat more than double that of the blades. The velocity of the jet is very high, from 2000 to 4000 feet per second, and for satisfactory economy the peripheral velocity of the wheel must also be very high. The passages between the moving blades are of uniform or even slightly increasing cross section from inlet to outlet. The moving blades check and reverse the velocity of the steam current, thus creating a force against the blades which sets the rotor in motion.

If the entire pressure drop takes place in one set of nozzles and the resulting jet is directed against a single wheel, the turbine is classified as belonging to the single stage, single velocity group, of which the DeLaval Class "A" turbine is a well known example.

We have just stated that for satisfactory economy the peripheral velocity of the wheel must be very high in turbines of this sort. However, it is possible to use a lower speed rotor by compounding the velocity. When this is done the jet issuing from the nozzle at a very high velocity is reflected back and forth from the vanes on the rotor to a series of fixed reversing buckets until all the available kinetic energy of the jet has been imparted to the wheel. An excellent illustration of this type of turbine is the Terry single stage machine.

Other means of combining low peripheral velocity and high efficiency is through pressure compounding. When this is done, expansion takes place in a series of successive nozzles instead of one nozzle. Thus, only a fraction of the available heat energy is converted into kinetic energy in each nozzle. For each set of fixed nozzles there is a corresponding rotor. To all intents and purposes this type of turbine consists of a series of single velocity impulse turbines placed side by side.

If we compound both velocity and pressure we have the multi-velocity and pressure type of which the Curtis turbine is the best known example.

Reaction Type Turbine

In the reaction turbine, approximately one-half of the expansion in any one stage takes place in the stationary blades, imparting to the steam a velocity substantially equal to that of the moving blades so that it enters them without impulse. The remainder of the expansion takes place in the moving blades, the spaces between which gradually grow smaller from inlet to the exit side of the turbine, thus forming a ring of moving nozzles. The velocity imparted to the steam by reason of the expansion occurring in the moving blades produce a reactive force on these blades which turns the rotor of the turbine.

Only a very small portion of the heat energy imparts velocity in the first set of fixed blades or nozzles. As the expansion is very gradual a large number of alternate fixed and revolving blades are necessary to effect complete expansion.

Combined Impulse and Reaction Turbines

In multi-stage work it has been found that the use of an impulse element for the first stage of expansion and the use of reaction elements for the subsequent stages form an effective combination. The impulse element replaces without any appreciable sacrifice of economy a considerable number of rows of reaction blades in the least efficient part of the reaction turbine, and makes possible a shorter, and, consequently, stiffer rotor. The Westinghouse Parsons double flow high pressure turbine is typical of this class.

Respective Advantages of Impulse and Reaction Turbines

The impulse and the reaction turbines represent two schools of engineering development, each of which secures practically the same result as the other but by slightly different means. It is fully as difficult to compare the advantages of one type of turbine over the other as it is to compare the respective advantages of horizontal and vertical water tube boilers. While many engineers can offer excellent reasons for preferring one type of turbine over the other, the fact remains that to a great majority of engineers

these reasons are comparatively unimportant, and their preference will depend not upon general considerations but upon the conditions obtaining in their individual plants.

It is plain that in the impulse type, because of the considerable differences in pressure which exist between adjacent stages and the fact that steam leakage increases as the square of the pressure drops, that it is very important that means be devised to minimize the leakage and resultant loss of efficiency. It has, therefore, been the universal practice with this type of turbine to employ a rotor built up of disks mounted on a through shaft of small diameter in order that the clearance between the shaft and diaphragm separating the pressure chambers may be as small as possible. This construction results in a light shaft which may develop deflection seriously. It is also

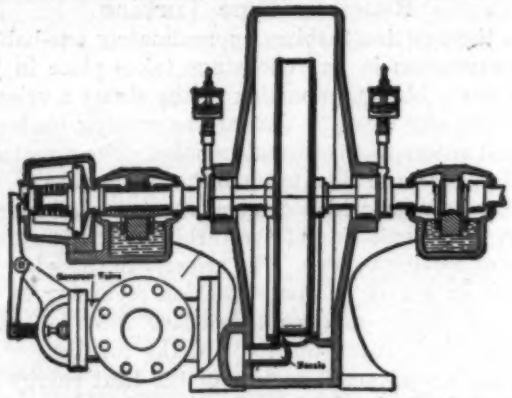


Fig. 1—Single Stage Terry Steam Turbine

claimed that the disks of the impulse turbine are subject to frequent temperature changes and because of these changes and the high velocities of which the turbine operates, the disks are to some degree liable to rupture.

An advantage claimed for the impulse turbine is that because the blades are very much larger and very much fewer in number than the reaction blades that there is considerable less difficulty in maintaining them.

For the reaction turbine it is claimed that the rotor, being made up of a comparatively thin cylindrical drum of considerable diameter with rings of large bore, that the internal strain in the disks is negligible. It has also been said that the drum construction of the rotor makes the reaction turbine very much more accessible for examination and repair.

It is well to remember, however, that the several types of turbines are made by concerns of the very highest standing in the engineering world, and this fact may be practically considered as a guarantee of the successful operations of the turbines produced by these manufacturers.

Terry Non-Condensing Turbine

In the Terry non-condensing turbine, Fig. 1, courtesy Gebhardt, the compounding of the velocity permits of much lower peripheral velocities than with the single-velocity type. The rotor, a single wheel consisting of two steel disks held together by bolts over a steel center, is fitted at its periphery with pressed-steel buckets of semi-circular cross section. The inner surface of the casing is fitted with a series of gun-metal reversing buckets arranged in groups, each group being supplied with a separate nozzle. The

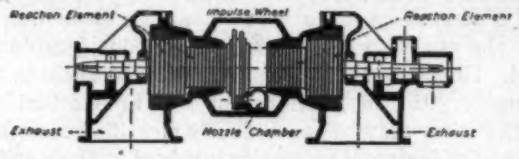


Fig. 2—Westinghouse Double Flow Turbine

steam issuing from nozzle N, at very high velocity, strikes one of the buckets, on the wheel, and since the velocity of the buckets is comparatively low, is reversed in direction and directed into the first one of the reversing chambers. The chamber redirects the jet against the wheel, from which it is again deflected; this is repeated four or more times until the available energy has been absorbed by the rotor. Terry turbines are made in a number of sizes varying from 5 to 800 horsepower, and operate at speeds varying from 210 feet per second in the smaller machine to 260 feet per second in the larger.

Kerr Turbine

The Kerr turbine, Fig. 2, is of unusual design in that it is built up in sections, the casing comprising a steam end, exhaust end, and whatever number of intermediate stages are best suited to meet the individual condition. The rotor consists of a series of steel disks, mounted on a rigid steel shaft. A series of drop-forged steel buckets is secured to the periphery and riveted in dovetailed slots. The tips of the buckets are riveted to a shroud ring, thereby insuring a rigid and positive spaced construction. The

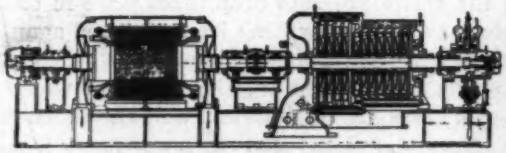


Fig. 3—Kerr Turbine

stator is made up of a number of arched cast-iron diaphragms with circular rims tongued and grooved, and bolted to steam-end and exhaust-end castings.

The operation is as follows: Steam enters the turbine through a double-beat balanced poppet valve, the stem of which is connected through levers to the governor, to the circular cored space extending around the steam "end casting." This space acts as an equalizer and insures uniform admission to the first set of nozzles. Partial expansion takes place through the first set of nozzles and the kinetic energy is imparted to the rotor through the medium of the vanes. Steam leaves the buckets at a very low velocity and is again

expanded through the second set of nozzles in the diaphragm. This process is repeated in each stage.

Westinghouse Turbine

In the Westinghouse impulse and reaction turbine, single-flow type, Fig. 3, the substitution of the impulse element for the high-pressure section of reaction blading has essentially no influence on the net efficiency of the turbine. That is to say, the efficiency of the impulse wheel is about the same as the least efficient section of reaction blading. This design is attractive, however, in that under some conditions it shortens the machine and gives a stiffer design of rotor.

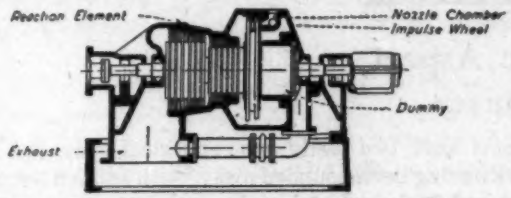


Fig. 4—Single Flow Turbine Combination Type

The entering steam is confined in the nozzle chamber until its pressure and temperature have been materially reduced by expanding through the nozzles. As the nozzle chamber is cast separately from the main cylinder, the temperature and pressure differences to which the cylinder is subjected are correspondingly lessened.

Westinghouse Double-Flow Turbine

The maximum economical capacity of a single-flow turbine is limited by the rotative speed. The economical velocity at which the steam may pas through the blades of the turbine depends on the velocity of the moving blades.

The capacity of the turbine depends on the weight of the steam passed per unit of time, which in turn depends on the mean velocity and the height of the blades. For a given rotative speed, the mean diameter of blade ring practicable is limited by the allowable stresses due to centrifugal force, and there is a practical limit for the height of the blades.

Now if we make the rotative speed only half as great, the maximum diameter of the rotor may be doubled and, without increasing the height of the blades, the capacity of the turbine will be doubled. So with the single-flow steam turbine as well as with the single-crank reciprocating engine, there is a practical limiting economical capacity for any given speed. If this limit is reached with a single-crank reciprocating engine, we may produce a unit of double the power at the same speed by coupling two single-crank engines to one shaft.

The Westinghouse double-flow turbine is in effect, as will be seen from Fig. 4, two single-flow turbines made up in a single rotor in a single casing with a common inlet and two exhausts. Steam enters the nozzle chamber, acts on the impulse element, and then the current divides, one-half of the steam going through the reaction blading at the left of the impulse wheel; the remainder passes over the top of the impulse wheel and through the impulse blading at the right.

Curtis Turbine

All General Electric Curtis turbines, ranging from the very small direct current machines to the huge turbo-alternator of 45,000 kw., are of the impulse type. So many changes are made in these, as well as in other turbines, from year to year, that descriptions can only be given in the most general terms.

In practically all sizes the high-pressure stage comprises a set of nozzles and a single wheel carrying two rows of buckets. Subsequent stages have but one row of buckets on a single wheel, except in the low-pressure element of the compound cylinder units where there are two wheels per stage, each with a single row of buckets. The steam flow is axial in all machines.

The speed in the smaller machines is controlled by a centrifugal governor, mounted on the end of the main shaft, which actuates a throttling valve of the balanced poppet valve type.

A relay governor of the hydraulic type controls the large turbo-alternators. Oil is fed to a cylinder under pressure through a pilot valve under control of the main governor. The piston rod of the cylinder contains a rack which meshes with the pinion on a camshaft which in turn lifts the individual control valves as determined by the spacing of the cams.

Fig. 5—1000-K. W. 60-Cycle General Electric Curtis Steam Turbine, with Automatic Extractor

Bleeder Type Turbine

One of the most interesting developments of the steam turbine is the so-called Bleeder or Extraction type. Steam is automatically bled from an intermediate stage for heating or manufacturing purposes after it has passed through and done work in the high pressure stages of the turbine. Steam is usually bled at from one to fifteen pounds pressure in quantities from a minimum amount up to the throttle capacity of the turbine.

It is probably due to the demands of the textile industry more than any other, that this type of turbine was developed. The steam, so bled, is absolutely free from oil and may be used for dye vats, bleaching,

slashing, etc., without any danger of injury to the product.

In conclusion it has only been possible here to describe in rather general terms the principles of operation and the details of construction by which the various turbines differ from each other.

For a discussion of the advantages and disadvantages of steam turbines, reference should be made to Part 1 of this article, published last month. It seems well in closing to emphasize again the fact that builders of turbines generally occupy a very high position in the engineering field, and that entire dependence can, as a general proposition, be placed upon the statements and recommendations of the various makers.

Log Barking

An Economic Aspect

By W. H. WHARTON

THE advances made during recent years in almost every branch of the paper making industry are so generally appreciated that little comment is necessary. In scarcely any other of our staple industries have such rapid and beneficial changes been made as in the production and quality of paper.

In view of such achievement it is surprising and somewhat regrettable that the preparation of the logs for this industry has not received more attention with a view to improvement and stricter economy in this operation. Several important factors have tended towards this condition. Possibly pulp and paper mill engineers have been too fully occupied in other directions. Another reason is the now exploded dogma of unlimited timber supply coupled with the once prevailing low cost of obtaining same at the mill site.

Present conditions and the popular demand for the better conservation of our natural resources warrant the application of our foremost minds and intellects to the study of this question. To be continually discounting the scientific efforts of our reforestation departments by actual and preventable waste of pulpwood is certainly not a step in the right direction. It is high time that a united effort be made to obliterate this waste by devising better ways and means for the storing and barking of our pulpwood logs.

Quite recently one of our eminent writers and students on this subject very clearly illustrated the disadvantage accruing from the prevailing practice of storing logs in the condition as cut. There are still but few concerns on this continent who fully appreciate the importance of this point, the majority continuing to accept a staggering yearly loss in decayed and damaged logs.

Next consider the operation of barking. One and all will agree that with the exception of very recent developments this operation is about as crude as possibly could be. The general method employed is to tumble the logs (after wasteful slashing into short suitable lengths) in cylindrical steel drums until the bark is removed. The pounding and hammering necessary in this operation is just as effective in damaging the logs as in obtaining the desired object, with the result that the logs upon being taken out of the drums have two badly split spherical ends, the corners having been pounded away, with splits filled with dirt and finely reduced bark.

In many cases the logs are next passed on to knife barkers where, on account of the inability of these machines to adjust themselves to the irregular shape of the logs, another loss, amounting to anywhere from 5% to 25% is occasioned. Where the logs are next passed to chipping machines, further loss or waste is experienced, owing to the splintered condition of the damaged ends.

The computation of the yearly loss occasioned in this manner must reach a staggering figure in an industry so extensive and of such national importance and warrants immediate remedies which can only be made by earnest and united effort on the part of all concerned.

Owing to reduced visible supply and ever increasing costs of pulpwood, some method must eventually be evolved to obviate the wasteful slashing into short lengths, to facilitate the stacking and storing of barked logs and to substitute a purely frictional action, for the removal of the bark and inner skins, for the illogical pounding action with its attendant inefficiency and other evils.

Several eminent engineers have been concentrating their efforts, during the past few years in an endeavor to attain these objects and from recent developments it appears that the day is not far distant when we shall be able to congratulate them upon their success and the service they have rendered to an important industry and their country.

Worth Remembering or Jotting Down

TO CONVERT gallons of water per second into pounds of water per minute multiply the former by 500.

Or, multiply the gallons of water per second by 1,000 and divide by 2.

To convert pounds of water per minute into gallons per second, divide the pounds of water per minute by 1,000 and multiply by 2.

Weights and Volumes of Pulp Stock

By F. H. SHILAND

WHENEVER the question comes up as to the capacity of stuff-chests, stuff-pumps, pipe lines for stock and horse-power needed to operate stuff-pumps, it is very convenient to have access to a table giving the weights and volumes of stock when containing various percentages of air-dry pulp.

Such a table has never to my knowledge been published. Some time ago in connection with some paper mill work, I compiled the table presented herewith and have found it of great value in saving many a tedious calculation.

For the benefit of anyone wishing to interpolate additional values or to extend the table, I am giving also the formulas used in determining the values in each column.

Percent on Pounds of Dry Stock = 100 Pounds of Liquid	Pounds of Dry Stock in 1 Cubic Foot of Liquid	Cubic Feet of Liquid Containing 1 Pound Stock	Pounds of Dry Stock in 1 Gallon of Liquid	Gallons of Liquid Containing 1 Pound of Stock	Liquid per Minute per Ton of Dry Stock per 24 Hours — Cubic Feet	Gallons	Pounds	Pounds of Water per Pound of Stock	Gallons of Water per Pound of Stock	Gallons of Water per Ton of Stock
.10	.0025	16.00	.0083	119.86	22.22	166.20	1388.89	999.00	119.86	239710
.20	.1250	8.00	.0167	59.77	11.11	83.10	694.44	499.00	59.80	119996
.25	.1562	6.40	.0201	47.87	8.88	66.49	555.55	399.00	47.76	95811
.30	.1875	5.33	.0250	39.90	7.41	55.41	462.96	332.33	39.78	79853
.33	.2063	4.80	.0278	35.91	6.66	49.86	416.64	297.10	35.56	71094
.35	.2187	4.57	.0292	34.20	6.35	47.50	396.83	284.71	34.08	68154
.40	.2500	4.00	.0333	29.92	5.55	41.55	347.22	249.00	29.80	59604
.45	.2812	3.56	.0376	26.62	4.94	36.94	308.64	221.22	26.49	52955
.50	.3125	3.20	.0420	23.92	4.44	33.25	277.77	199.00	23.82	47636
.55	.3437	2.91	.0464	21.76	4.04	30.22	252.52	180.82	21.64	43284
.60	.3750	2.66	.0500	19.94	3.70	27.71	231.48	166.66	19.83	39666
.65	.4062	2.46	.0534	18.41	3.42	25.57	213.68	152.85	18.29	36569
.70	.4375	2.28	.0588	17.10	3.17	23.75	198.42	141.86	16.98	33957
.75	.4687	2.13	.0638	15.96	2.96	22.16	185.18	132.33	15.84	31678
.80	.5000	2.00	.0667	14.96	2.78	20.78	173.61	124.00	14.84	29683
.85	.5312	1.88	.0711	14.06	2.61	19.56	163.40	116.66	13.96	27922
.90	.5624	1.83	.0750	13.71	2.47	18.47	154.32	110.11	13.18	26366
.92	.5937	1.68	.0799	12.61	2.34	17.50	146.19	104.26	12.48	24958
1.00	.6250	1.60	.0834	11.97	2.22	16.62	138.88	99.00	11.86	23699
1.25	.7812	1.28	.1042	9.57	1.78	13.30	111.11	79.00	9.48	18911
1.50	.9375	1.07	.1250	7.98	1.48	11.08	92.59	65.66	7.86	15712
1.75	1.0937	.91	.1466	6.84	1.27	9.50	79.37	56.14	6.72	13439
2.00	1.2500	.80	.1667	5.97	1.11	8.31	69.44	49.00	5.86	11729
2.25	1.4062	.73	.1868	5.49	.99	7.39	61.73	43.44	5.20	10399
2.50	1.5625	.64	.2039	4.79	.89	6.65	55.55	39.00	4.67	9335
2.75	1.7187	.58	.2330	4.36	.81	6.04	50.50	35.36	4.23	8465
3.00	1.8750	.53	.2551	3.99	.74	5.54	46.29	32.33	3.87	7740
3.50	2.1875	.46	.2912	3.42	.63	4.75	39.68	27.87	3.30	6600
4.00	2.5000	.40	.3334	2.99	.55	4.16	34.72	24.00	2.87	5745
4.50	2.8125	.36	.3756	2.74	.49	3.69	30.86	21.22	2.54	5080
5.00	3.1250	.32	.4178	2.39	.44	3.32	27.77	19.00	2.27	4536
5.50	3.4375	.29	.4599	2.18	.40	3.02	25.25	17.18	2.06	4113
6.00	3.7500	.27	.5001	1.99	.37	2.77	23.14	15.66	1.87	3750
6.50	4.0625	.25	.5442	1.85	.35	2.57	21.43	14.38	1.72	3440
7.00	4.3750	.23	.5894	1.71	.33	2.38	19.85	13.29	1.59	3180
7.50	4.6875	.21	.6326	1.60	.29	2.22	18.51	12.33	1.48	2960
8.00	5.0000	.20	.6667	1.50	.28	2.08	17.36	11.50	1.38	2760
8.50	5.3125	.19	.7099	1.41	.26	1.96	16.35	10.76	1.29	2580
9.00	5.6250	.18	.7511	1.33	.25	1.85	15.43	10.11	1.21	2423
9.50	5.9375	.17	.7942	1.26	.24	1.75	14.60	9.53	1.14	2280
10.00	6.2500	.16	.8344	1.20	.22	1.67	13.93	9.00	1.08	2160

To illustrate some uses of the table, the following examples are given:

1. What capacity will be required in a stuff-chest to hold a three percent mixture containing three 2,000-pound beaters of air-dry pulp?

Three 2,000-pound beaters is equivalent to 6,000 pounds of air-dry pulp. Referring to the table in Column 3 opposite 3.00% we find that 0.53 cubic feet of 3.00% stock contains one pound of air-dry pulp. Therefore, the required capacity must be

$$6{,}000 \times 0.53 \text{ or } 3{,}180 \text{ cubic feet.}$$

2. What must be the discharge in gallons per minute of a stuff-pump handling 2.50% stock to supply a paper machine producing 40 tons per 24 hours, making no allowance for overflow back to chest or pump slippage.

Referring to the table in Column 7 opposite 2.50% we find that the pump must handle 6.65 gallons per minute per ton of paper produced per 24 hours. Hence, the discharge in gallons per minute for a 40-ton machine must be

$$40 \times 6.65 \text{ or } 266 \text{ gallons per minute.}$$

If we assume a 25% overflow back to the chest and a 10% pump slippage we find as the required capacity

$$1.10\ (266 \times 1.25) \text{ or } 366 \text{ gallons per minute.}$$

3. If the stock has to be pumped against a total head of 30 feet, including pipe friction, and the pump efficiency is 65%, what horse-power will be required to operate it, assuming the same overflow and pump slippage as in the previous problem?

Referring to the table in Column 8 opposite 2.50% we find the number of pounds per minute per ton of production per 24 hours is 55.55. Then the horse-power required will be

$$\frac{1.10\ (55.55 \times 1.25) \times 40 \times 30}{33{,}000 \times 0.65} \text{ or } 4.27 \text{ horse-power}$$

Formulas for Table

Column No.	Successive Formulas	Formulas as Referred to Column 1
2	$\frac{\text{Column 1} \times 62.5}{100}$	Same
3	$\frac{1}{\text{Column 1}}$	Same
4	$\frac{\text{Column 1} \times 8.34}{100}$	Same
5	$\frac{1}{\text{Column 4}}$	$\frac{100}{\text{Column 1} \times 8.34}$
6	Column 3 x 1.389	$\frac{1.389}{\text{Column 1}}$
7	Column 5 x 1.389	$\frac{138.9}{\text{Column 1} \times 8.34}$
8	Column 7 x 1.389	$\frac{192.9}{\text{Column 1} \times 8.34}$
9	$\frac{\text{100.00-Column 1}}{\text{Column 1}}$	Same
10	$\frac{\text{Column 9}}{8.34}$	$\frac{\text{100.00-Column 1}}{\text{Column 1} \times 8.34}$
11	Column 10 x 2000	$2000 \times \frac{\text{100.00-Column 1}}{\text{Column 1} \times 8.34}$

Steam Saving Effected by Soot Blower

ONE of the outstanding features of the new Soot Blower shown in Figure 1, is the steam saving effected by the unit valve being open just long enough to have the jets pass over the part of the tubes to be cleaned. With the cam adjusted to hold the valve open for 300 degrees, the head uses steam from five to seven seconds per revolution. As the gear reduction assures turning of the element slowly and steadily, it is rarely necessary to revolve the blower more than two or three times. This means

Fig. 1—Valve-in-Head Soot Blower

that steam is being used from fifteen to twenty-one seconds per unit per blowing.

In contrast the valve of the plain revolving soot blower is necessarily open from 45 to 75 seconds, 60 seconds being the average time required for close attentive operation.

At this point it is well to observe that very few men operating soot blowers realize the importance of giving proper attention to the steam loss due to unit valves being kept open longer than necessary to clean the boiler properly. We have timed a large number of soot blower operations, many of them without the knowledge of the operator, and it has been surprising to note the frequency with which the unit valves are kept open two or three minutes and even longer, while keeping the valves open from a minute and half to two minutes is common practice. Figure 2 is a chart from which the steam loss from excessive blowing can readily be computed. The vertical column of figures at the left is the steam pressure in the header when blowing, while the figures at the bottom show the amount of steam that will pass through a standard 5/16" soot blower nozzle at the various pressures in a given time.

The point at which the slanting lines intersect vertical lines for a given pressure indicates the steam flow through the nozzle for the time marked on each slanting line. By this method we find that with 100 pounds header pressure, 2.4 pounds of steam will flow through a nozzle if the valve is open 30 seconds, while 9.6 pounds will be used if the valve is left open 120 seconds.

Taking a standard 21 wide B&W boiler, we find we have five units of 20 jets each or 100 jets. To blow this boiler by the Valve-in-Head system with the valves open 30 seconds each will require 240 pounds of steam, while with the independent valve soot blower if the valves are open 120 seconds each, 960 pounds of steam will pass through. If the boiler can be properly cleaned with the valves open 30 seconds, the loss would be 720 pounds per blowing, or 2,160 pounds in 24 hours, if the blowers were used three times a day. With the boiler in service 300 days a year, the steam loss would be 648,000 pounds. To reduce this loss to dollars and cents it is only necessary to multiply the cost of the steam from 20 to 70 cents per thousand pounds, by 648. If the steam costs 50 cents per thousand pounds, the loss for the boiler described above would be $324.00 per year.

The chart, Figure 3, shows the total steam consumption for a five unit 21 wide installation, on which the header pressure is 100 pounds with the unit valves open from 10 to 130 seconds. Figure 4 shows the total steam consumption of installations on a 21 wide boiler with 100 pounds' header pressure, having from one to fifteen units and blowing from 15 to 120

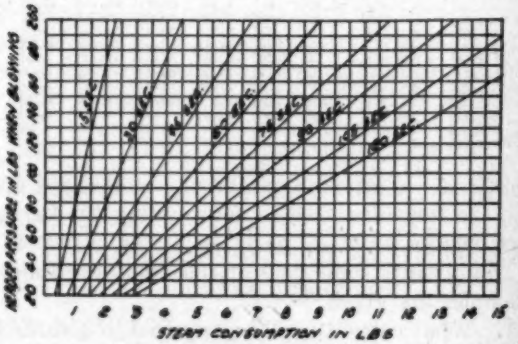


Fig. 2—Steam consumption for single 5/16" jet. Header pressure 40 to 120 lbs. when blowing. Valve open 15 to 120 seconds

seconds each. From this it will be seen that a boiler with 14 units, having 20 jets each, and with 100 pounds' header pressure, will require 690 pounds of steam per blowing, if the valves are open 30 seconds

each, while 1,725 pounds will be required if the valves are left open 75 seconds each.

It should be noted that the pressures given are for the header while blowing. With one unit valve open, the header pressure will be from 50 to 80 per cent of the boiler pressure, depending on the size of the piping, the bends and valves in the line, the number of jets on the unit and other conditions. The header pressure will always be somewhat higher than the pressure in the blower element, due to friction between the header and the element and in the element. This will also account for the discrepancies between these charts and the results obtained by the use of Napier's Formula.

These charts have been compiled from data collected while making tests on soot blowers at one of the largest power plants in the United States under conditions which assure their accuracy.

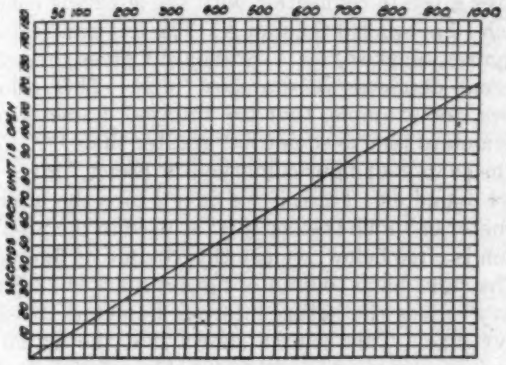


Fig. 3—Steam consumption in lbs. per 5 units on boiler 21 tubes wide. 100-lb. pressure when blowing

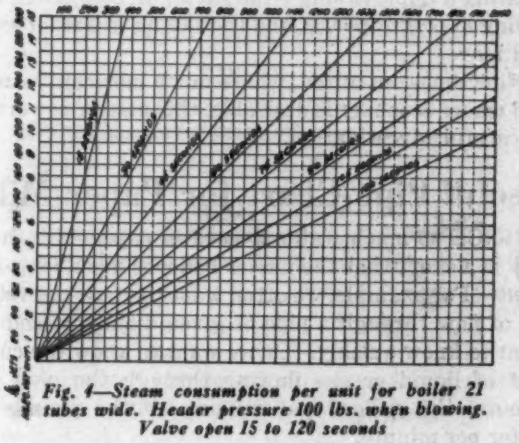


Fig. 4—Steam consumption per unit for boiler 21 tubes wide. Header pressure 100 lbs. when blowing. Valve open 15 to 120 seconds

Pointers for the Engineer

W. F. SCHAPHORST, M. E.

Cheap Lubricating Oil

IT ALWAYS pays to use a good grade rather than a poor grade of lubricating oil.

Never buy oil simply because it is cheap, because it may prove, in the end, to be expensive.

In many instances it has been found that by abandoning the use of a cheap lubricant and substituting a higher grade, although slightly more costly lubricant, the friction load has been reduced 20 per cent or even more, which may be a considerable item in many plants.

The first question, however, that the owner or official may ask is: "What is my friction load and what will be the dollars and cents saving per year if I can reduce my friction load as much as 20 or 25 per cent by using a higher grade oil?"

To determine the friction load, possibly the best method is to use a steam engine indicator if the plant is driven by a steam engine, or if it is motor driven, it is a simple matter to determine the friction load by simply taking readings on the switchboard with all machines running, but running "empty." That is, the friction load is the power required to drive all machines in the plant while they are "unloaded" and are not doing any useful work. If the steam engine indicator shows that the friction load is 10 horsepower, it means of course that 10 horsepower are required to drive all machines empty, and it means that this much power is being used for overcoming the friction load all day long even when the machines are loaded. The useful work is simply an additional load added to the friction load, the friction load being practically constant at all times. The same is true for motor driven machines as well as for steam engine driven machines.

If, for example, it is found that the friction load in your plant is 10 horsepower, and the cost of power is only 2c per horsepower per hour, the cost of the friction horsepower alone would mean 20c per hour, or $2.00 per 10 hour day. Assuming 300 working days per year, the cost of the friction horsepower per year would be $600.00. Then if it is possible to reduce the friction load by 20 per cent by using a better lubricant the saving per year would be (20% x $600.00) $120.00 in power alone. In addition to this, the reduction in friction load means that there would be less wear in the bearings, the belts would be capable of pulling a greater load because they would not be stressed so much, and altogether the saving would amount to more than $120.00 per year. For that amount of money a great deal of lubricant can be purchased and it surely becomes perfectly evident that it pays and

pays well to spend "just a little more" money if need be for a higher grade of lubricant.

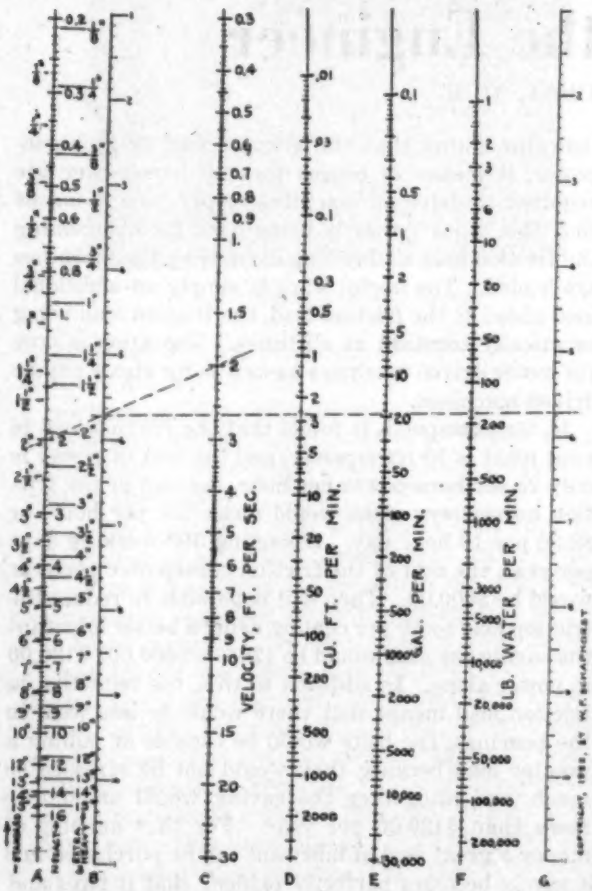
Of course, it is foolish to pay a high price for oil for the mere sake of paying a high price. If indicator or switchboard tests show that the more costly lubricant does not reduce the friction load, it is good economy to go back to the former and less expensive oil. In fact, this writer knows of instances where less costly oil has actually given better results than a higher priced oil in the matter of friction load, thus creating a triple saving—the saving in cost of oil, the saving in cost of power, and the saving in cost of wear and tear.

Nine times out of ten, where much lubricant is used and where economy is desirable, this matter is worthy of careful investigation.

Useful Pipe Chart for Paper Mills

SINCE so much water is used in paper mills, here is a chart that the writer believes fills a long-felt want. For example, we often want to know the velocity of flow through a pipe of given diameter, and we want to know quickly. Or we want to know the cubic feet of liquid or gas flowing through the pipe per minute, the gallons per minute, or the pounds of water per minute.

All of these quantities are dependent, of course, upon the size of the pipe, and since pipe sizes vary, standard pipe not being exact in internal diameter and extra heavy pipe being different also it is always necessary to search through tables and make lengthy calculations before arriving at the result. And then, after a result is arrived at, one is not certain that the answer is correct.



Here is a chart that takes care of all of these matters in a decidedly simple way. The best way to explain the use of the chart is to give a problem. First it will be observed that there are three sets of figures given in connection with the left hand column which I have called Column A. The left hand column of figures, marked "No. 1, Standard," gives the actual internal diameter of standard pipe. This column shows, for example, that the internal diameter of a 1″ standard pipe is somewhat greater than 1″.

The column of figures marked "2 Exact," gives the exact diameter. Thus, if we have a pipe the internal diameter of which is exactly 2″ as used in the problem which is cited below, we use this column of figures.

The right hand column of figures marked "3 Extra Heavy" gives the actual internal diameters of extra heavy pipe. This column shows that the actual internal diameter of a 1″ extra heavy pipe is less than 1″.

For example, how much water is passing through a pipe, the internal diameter being exactly 2″ and the velocity of the water being 2 feet per second?

Locate the 2 in Column A over the word "Exact" and from its point of intersection run a straight line through the 2 feet per second in Column C as shown by the dotted line. This straight line intersects Column B. From the point of intersection in Column B, run a straight line over to the similar point in Column G, also as shown by the dotted line. The intersection of this perfectly horizontal line from Column B to Column G gives answers simultaneously in three columns—Columns D, E, and F. It shows that:

2.6 cubic feet per minute are flowing through the pipe. (The correct amount is 2.615 cubic feet.)

A trifle over 19 gallons per minute are flowing through the pipe. (The correct amount is 19.58 gallons.)

About 165 pounds of water per minute are flowing through the pipe. (The correct amount is 163 pounds.)

This shows that the chart is very accurate—surely accurate enough for all practical purposes.

It is evident, now, on studying the chart that if the pipe were a two-inch "standard" pipe instead of exactly 2 inches, the horizontal line from Column B to Column G would be slightly lower and the three quantities would be slightly greater.

On the other hand it is also evident that if a two-inch extra heavy pipe were used instead of the two-inch exact, the horizontal line from Column B to Column G would be raised slightly above its present

position and the three quantities would therefore be slightly less.

Inversely, if any quantity in Column D, E or F is known and it is desired to determine the velocity per second flowing through the pipe, this same chart can be used with equal ease. First run the horizontal line from Column B to Column G through the known point and then through the located intersection in Column B, run a straight line from the known pipe diameter, and the intersection with Column C immediately gives the velocity in feet per second.

Or, if one wishes to select a pipe size knowing any one of the quantities in Columns D, E or F and having decided upon the velocity of flow, it is perfectly evident what to do.

At the same time, it will be noted that this chart can be conveniently used as a conversion chart. For example, how many gallons in 2.6 cubic feet? The dotted horizontal line already drawn shows that the answer is slightly over 19 gallons which is also equivalent to about 165 pounds of water.

At the same time this chart gives a visual demonstration of the relationship of pipe sizes, standard, exact, and extra heavy. By using this chart one can quickly "read off" the correct internal diameter of a standard or extra heavy pipe.

The range of this chart has been made great enough to take care of almost any problem dealing with water, the standard pipe sizes ranging from ⅛" to 15" and the velocities from 0.3 to 20 feet per second.

Should anybody prefer to use formulas rather than this chart, either for solving the problem directly, or checking the results taken from the chart, here are the formulas on which the chart is based:

$$Q = 2.45\, d^2 V$$

Where Q = gallons per minute
d = internal diameter inches
V = velocity, feet per second

Cubic feet per minute $= 0.327\, d^2 V$
Pounds water per minute $= 20.4\, d^2 V$

Thou shalt guard thyself with all diligence; this is the first and greatest commandment of Safety First. The second is like unto it: Thou shalt guard thy neighbor as thyself, says the National Safety Council.

If you prefer to be accepted in the world's market as linen and bond, do not make a blotter out of yourself.—R. L. S.

BAYLESS MANUFACTURING CORPORATION

DAILY FITTING REPORT

DEP'TS.	Plugs		Ells		St. Ells		Flang Ells		Tees		Unions		Valves		Pipe		Bushings		Couplings		Flanges		Brass Fit.			Misc
	No.	Size	No.	Size	No.	Size	No.	Size	No.	Size	No.	Size	No.	Size	Ft.	Size	No.	Size	No.	Size	No.	Size	No.	Size	Kind	
Wood Room																										
Wet Room																										
Beat'r Room																										
Mach. Room																										
Finish Room																										
Ship. Room																										
Acid Room																										
Eng. Room																										
Boiler H'se																										
Chem'l Pl't																										
Fire Line																										
Outside Wrk																										
Bleach Pl't.																										
Offices																										
C. Power H.																										

*Date*_____

*Signature*_____

REMARKS:—

_____

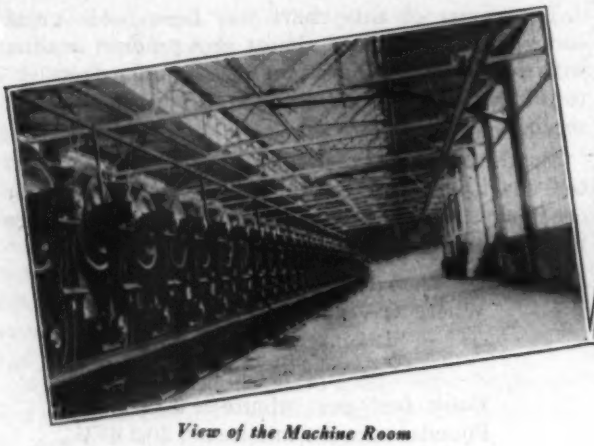
_____

_____

_____

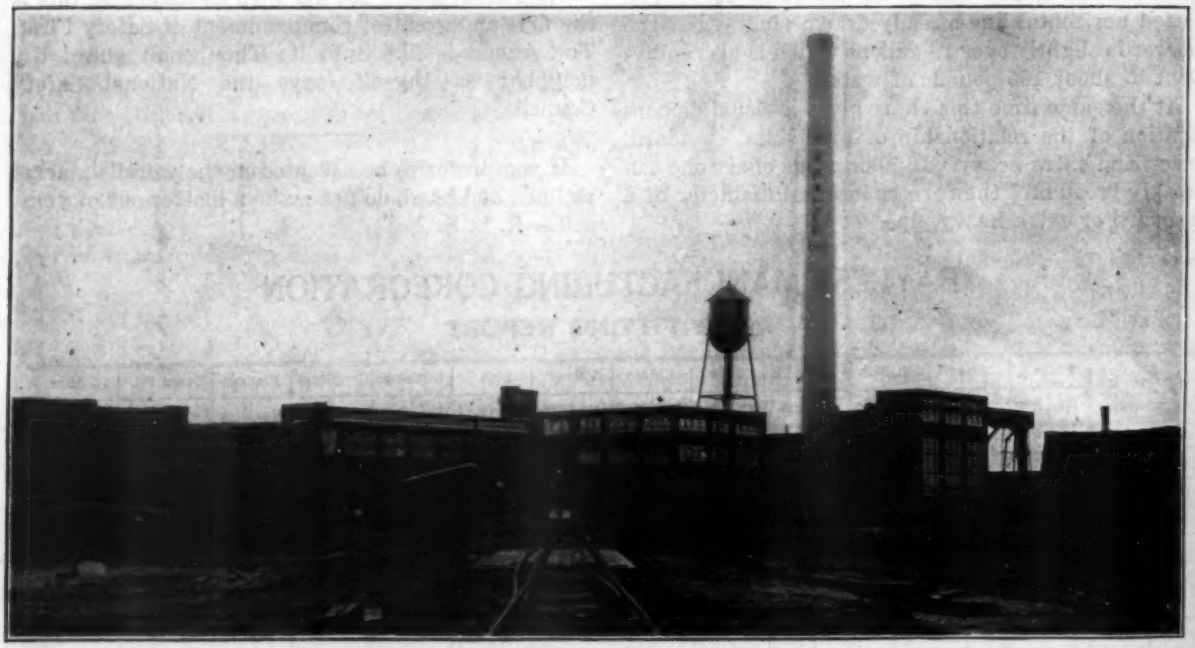
_____

In a pulp and paper mill it is very hard to keep track of fittings used for repair work in various departments, so this Daily Fitting Report was drawn by John A. Kagerhuber, a mechanical and consulting engineer of Austin, Pennsylvania

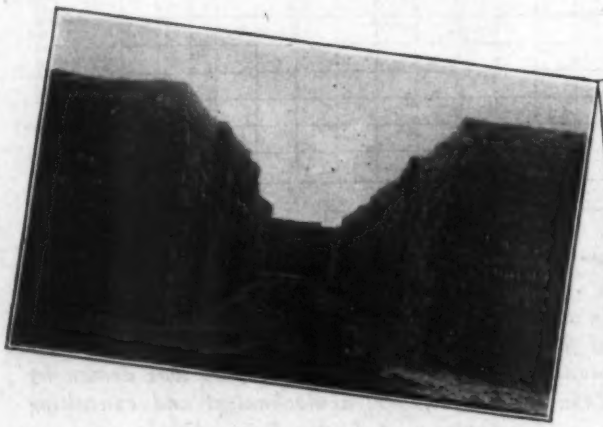


View of the Machine Room

View of the Steam Turbine Room



The new Mill of the Hinde & Dauch Paper Company, at Fort Madison, Iowa



A Real Pile of Straw—About 15,000 Tons of It

System to Convey Straw from Wagons or Cars Into the Mill

The New Hinde & Dauch Mill

AMONG the new paper mills recently started and possibly the best one of its kind in this country is the new mill built by the Hinde & Dauch Paper Co., at Fort Madison, Iowa. This company bought the plant formerly known as the Brown Paper Co., and now operates the old as well as the new plant.

The new plant and its completion is to a large extent the dream and development of J. W. Harbrecht, vice-president of the company and general superintendent of all of the company's plants. Hardy S. Ferguson, Consulting Engineer of New York, was the architect and made all of the plans for the plant.

This is not only a wonderfully fine mill, but it was built in record time. The ground was broken on the 25th of April, 1921, and the equipment was installed and started up on December 22, 1921. The first paper was made on February 27, 1922, or just ten months following the day that ground was broken. The second day that the machine was in operation, it ran continuously for twenty-six hours without a break. The machine, which will be devoted continuously to the making of strawboard for corrugating, was built by the Downingtown Manufacturing Co., East Downingtown, Pa. It is a Fourdrinier machine with a wire 55 inches long and 142 inches wide. It has sixty 42-inch dryers, 138 inches wide, is equipped with all of the latest devices, two stacks of calenders, one a seven roll and the other a nine roll stack.

The output of the machine has been materially increased by its being equipped with a vapor absorption system, installed by the J. O. Ross Engineering Corp., of New York. The United States Rubber Co. furnished all of the rubber goods equipment, and Armstrong traps are now being installed by the Armstrong Machine Co., Three Rivers, Mich. S. K. F. ball bearings are used on the machine.

The machine room, which was built for only one machine, is 45 feet wide and three hundred feet long. A hand operated crane travels the full length of the room, and this was furnished by the Chisholm & Moore Co., Cleveland, O.

The structural part of the buildings was furnished by the Worden-Allen Co., Chicago. Abundance of light is provided for by the use of Daylight Fenestra windows, furnished by the Detroit Steel Products Co., Detroit, Mich. The buildings are covered with gypsum roofs, furnished by the Lathrop-Hoge Construction Co., of Cincinnati, O.

The entire plant covers approximately 60,000 square feet of ground space, which is a small part of the thirty-seven acres owned by the company. The shipping room section is 114x228 feet. The raw paper stock department occupies two floors, the two having 14,338 square feet of space.

One of the interesting parts of this mill is the rotary room, shown in the illustration. It is of steel construction, with more light than is usually found in such rooms, and contains twelve large rotaries, built by the Biggs Boiler Works, Akron, O. The beater room contains seven 1500-pound Downingtown beaters, equipped with washers, and three large Jordans, furnished by Shartle Brothers Machine Co., Middletown, O. The Downingtown Co., also furnished the stock pumps. The plant is equipped throughout with Toledo scales, made by the Toledo Scale Co., Toledo, O.

The paper machine as well as most of the other machinery is operated electrically. All of the electrical equipment was installed by the Nutting Electric Co., Muncie, Ind., and was in the most part furnished by the General Electric Co., Schenectady, N. Y. The main line shaft is driven by a direct connected 200 H. P. motor; the line shaft is equipped with Fafnir bearings.

The power equipment consists of a large Curtis type steam turbine, receiving power from Babcock & Wilcox Sterling type boilers, equipped with stokers furnished by the same company.

Twelve 14-ft. Biggs Rotaries in the Hinde & Dauch Paper Co. (Strawboard Mill), Ft. Madison, Iowa

Link-Belt Co., Chicago, furnished the coal conveying and handling equipment, while the Kerr Turbine Co., Wellsville, N. Y., supplied the turbine which drives the big condenser furnished by the Wheeler Condenser & Engineering Co., Carteret, N. J.

The DeLaval Steam Turbine Co., Trenton, N. J., furnished the high pressure centrifugal pumps, driven by turbines furnished by the same company. This company also furnished the centrifugal pumps for the water service. Sturtevant fans are used in the plant, and considerable spiral pipe, furnished by the American Spiral Pipe Co., Chicago.

The H. S. B. W. Cochrane Co., of Philadelphia, furnished a 10,000 gallon water softening plant, to furnish soft water for the boilers. The Crane Co., Chicago, furnished most of the piping equipment, though part of it was furnished by the Walworth Mfg. Co., Boston, Mass. The Worthington Pump Co. furnished the deep well pumps. The Pittsburgh-Des Moines Steel Co., Des Moines, Iowa, built the large steel tank and tower to furnish the water for the sprinkler system.

The lighting reflectors were furnished by the Benjamin Electrict Co., Chicago. The largest smoke stack in the state of Iowa was built by the American Chimney Corporation, of New York City. It is 231 feet high, thirty-eight feet in diameter at the base, and ten feet in diameter on the inside at the top.

A monster conveying system has been installed, the equipment having been furnished by the Webster Mfg. Co., Chicago, so that straw can be unloaded from cars or teams and conveyed directly into the mill.

Immense piles of baled straw meet one's gaze as soon as they approach the plant. The piles shown in the picture contain about 15,000 tons of straw, and will furnish material for the plant for from four to five months.

The plant is situated on the banks of the Mississippi river. It has docks for conveying material by water if desired, and has also connection with two important railroad lines. It is situated in a great straw producing territory, and is altogether a wonderful plant at an ideal location.

Newsprint Statistical Review

The News Print Service Bureau has issued the following statistical review on newsprint for the first quarter of 1922.

Production, shipments and stocks for the first three months of 1922 compare with the same period in 1921 as follows:

Production—3 Months

	1922 Tons	1921 Tons	Increase %
Canada	245,685	200,744	22
United States	321,101	334,402	(a) 4
Total	566,786	535,146	6

(a) Decrease.

Shipments—3 Months

	1922 Tons	1921 Tons	Increase %
Canada	251,603	193,120	30
United States	316,855	317,376	..
Total	568,458	510,496	11

Mill Stocks on March 31

	1922 Tons	1921 Tons	Decrease %
Canada	7,919	18,663	58
United States	28,180	41,789	32
Total	36,099	60,452	40

Imports

Imports of news print from Europe since September, 1920 (the date of the first German paper), have been as follows:

(Tons)

1920—	Germany	Sweden	Finland	Norway	Other Countries	Total
September	676	1,414	.....	.....	933	3,023
October	2,125	31	.....	58	.....	2,214
November	4,059	2,920	.....	1,471	.....	8,450
December	14,306	5,268	2,797	839	404	23,514
1921—						
January	4,061	1,991	2,912	5,612	327	14,903
February	5,642	694	417	2,853	68	9,674
March	3,740	5,600	5,358	1,229	62	15,989
April	1,329	3,622	1,763	522	670	7,906
May	1,669	37	9	2,314	21	4,050
June	97	2,600	1,062	56	743	4,558
July	4,586	2,344	11	.....	994	7,935
August	4,289	5,797	3,894	2,163	389	16,532
September	4,920	5,791	2,490	1,093	189	14,483
October	4,140	5,405	1,469	180	144	11,338
November	2,295	5,416	1,110	1,736	720	11,277
December	2,170	9,635	2,166	2,430	291	16,692
1922—						
January	3,476	5,452	839	2,376	127	12,270
February	3,098	10,871	2,263	2,431	212	18,875
March	2,086	532	657	1,262	363	4,900
Total	68,664	75,420	29,217	28,630	6,652	208,583
Average for 19 months						10,977
Average for last 8 months						13,298

Consumption

Consumption of news print paper in the United States has been as follows during the first three months of 1922, 1921 and 1920:

(Round numbers only.)

	First three months 1922 Tons	1921 Tons	1920 Tons	1922 compared with 1921 % Inc.	1920 % Inc.
Total print—					
Mill shipments	317,000	317,000	359,000	..	(a) 12
Imports	243,000	195,000	165,000	25	47
Totals	560,000	512,000	524,000	9	7
Less exports	6,000	6,000	10,000	..	(a) 40
Supply, total print	554,000	506,000	514,000	9	8
93% standard news	515,000	471,000	478,000	9	8
Less increase or plus decrease in publishers' stocks	+2,000	—4,000	+13,000	..	..
Net consumption standard news	517,000	467,000	491,000	10	5

(a) Decrease.

Publishers Tonnage

The consumption and stocks of the publishers reporting to the Federal Trade Commission have been as shown below for the last 12 months. These publishers use over 90% of the total consumption of news print paper in the United States:

Month—	Firms	Stocks used and sold during month	Stocks on hand or in transit end of month	Days' supply
April, 1921	663	148,427	243,901	49
May	664	152,278	217,244	44
June	664	148,604	194,444	39
July	661	139,121	194,104	44
August	661	132,808	212,191	50
September	661	140,758	212,991	45
October	661	160,563	211,276	41
November	661	158,193	204,798	39
December	661	163,560	196,741	37
January, 1922	665	156,333	192,416	38
February	664	149,862	200,595	37
March	664	169,574	194,904	36

Consumption of news print paper by the publishers reporting to the F. T. C. has been as follows during the first quarter of the last 4 years:

	Tons	Tons	Increase over 1919 Percent
1919	383,521	.....	..
1920	446,618	63,097	16
1921	431,171	47,650	12
1922	475,769	92,248	24

The consumption by these reporting publishers during the first 3 months of 1922 was 24% greater than in the same period in 1919, 7% more than in 1920 and 10% more than 1921.

Pages Printed

The daily and Sunday newspapers of the United States with a circulation in excess of 100,000 copies have averaged the following number of pages during the first 3 months of the last 3 years:

	Dailies			Sundays		
	1922	1921	1920	1922	1921	1920
January	23	22	23	80	76	80
February	23	22	22	85	77	79
March	25	23	23	91	83	84
Average	24	22	23	85	79	81

Advertising

Newspaper advertising in 27 leading cities compares as follows for the first 3 months of 1922 and 1921:

	1922	1921	Increase %
January	95,630,320	95,291,967	..
February	84,042,100	83,889,774	..
March	104,509,442	102,245,282	2
Total	284,181,862	281,427,023	1

Periodical advertising for the first four months of 1922 compares as follows with the same period in 1921:

	1922	1921	Decrease %
January	1,111,600	1,541,589	28
February	1,382,616	1,695,181	19
March	1,515,325	1,654,826	8
April	1,716,938	1,736,722	1
Total	5,726,479	6,628,318	14

Market Prices for Machine Wires

The Armstrong Bureau of Related Industries for its clients, the manufacturers of machine wires, furnishes for publication the following prevailing market price information on brass Fourdrinier wires (new standard) at last quoted to the trade by the respective sellers and cleared through the Bureau:

	Price per sq. ft.
No. 60 mesh	50c- 51c
No. 65 mesh	52c- 53c
No. 70 mesh	56c- 57c
No. 75 mesh	59c- 62c
No. 80 mesh	61c-

Technical Association Papers

The following papers were presented at the seventh annual convention of the Technical Association of the Paper Industry, held at the Waldorf-Astoria Hotel, New York City, from April 10 to 12 inclusive

The Chemistry of the Sulphite Process

By R. N. Miller[1] and W. H. Swanson[2]

IN spite of the great advances that have taken place in the manufacture of sulphite pulp, there remains much uncertainty, lack of knowledge, or misinformation relative to the progress of the reaction and the conditions under which it must take place to produce pulp of the desired properties.

It has been long accepted that the fundamental reactions in the cooking of sulphite pulp are a hydrolyzing action and a sulfonation which separate the ligneous material from the fibers and transform it into a substance that is soluble in water. Much work has been done to determine the constitution of the materials dissolved and from the knowledge of the end products the course of the reaction has been deduced. The names of Klason, Schwalbe, Heuser, Klein and their coworkers head a long list of those who have contributed to the knowledge of the composition and reactions of the materials dissolved from the wood in the course of the cook. When, however, information is sought as to the method by which sulphite with the desired properties is to be made, the conditions under which it must be cooked, the strength of acid to be used, etc., one is at once struck by the dearth of exact public information of a fundamental character. Much of this information is the property of every well operated sulphite mill and is the accumulation of years of experience, but it is also true that knowledge applicable in one mill may not be at all applicable in another.

It is the purpose of this paper to bring out the methods by which it is hoped to arrive at the fundamental knowledge of the sulphite process, and to show their application to the preliminary study as carried out in one series of cooks at the Forest Products Laboratory.[3]

Method of Attack

It was thought that if information could be obtained covering the composition of the cooking acid, the character of the pulp, and the nature and amount of materials that had been removed from the wood at different stages in the cook, conclusions could be drawn as to what had happened in the digester; and if a series of cooks could be made under the same conditions, and blown prematurely, examination of the pulp and liquor at the end of each prematurely blown cook would be equivalent to examining them at intervals during a single cook. In fact, the only way to get a sample of pulp that will really show the changes taking place in the wood and be representative of the digester contents is to blow and sample the entire charge.

To avoid entirely the effect of the variable of dilution from condensed steam, it was decided after some preliminary cooks to make the cooks of this series by heating with indirect steam. The temperatures and pressures decided upon were within the range of any mill, and the strength of acid while not that which has become generally recognized as the most desirable to use, is the same as that being used in a plant in this country to produce a pulp of very high grade. The duration of cook and the temperature rise was that which preliminary trial showed would produce a pulp comparable to commercial pulps in point of strength. The approach to uniformity of conditions can be judged by the table, Fig. 1, which is that of the total SO_2 content in percent in all cooks at all sample periods.

It is proposed to continue this work using direct steam as the source of heat and numerous other acid compositions and temperature-pressure combinations, but in this preliminary study the conditions easiest to control were selected.

Apparatus

The digester, having a capacity of about 50 lbs. pulp, at the Forest Products Laboratory, was used in this series of cooks. This digester is a replica of the ordinary upright digester, and has, in addition to the direct steam heating connections, a lead coil installed in the lower half of the digester for indirect heating. A separator was installed below the relief cooler and a receiver connected to catch all condensable relief. The gaseous relief was caught in a tank of water. To make possible the drawing of cold samples from the digester a small lead pipe cooler was attached to the sample plug. This arrangement made it possible to check up on the quantities of materials that were in the digester, or in the relief receiver, or the gas absorption tank at any time in the course of the cook, and thus locate the various reagents at all times.

FIG. 1.—TABLE OF CONCENTRATION OF SO_2 IN ALL COOKS.

Cook No. Hours	630-I	629-I	626-I	625-I	634-I	633-I	631-I	632-I
4	3.14	3.02	3.06	2.90	3.05	2.89	2.99	3.18
7	2.36	2.40	2.48	2.44	2.36	2.28	2.38	2.52
9	...	1.50	1.71	1.57	1.36	1.35	1.48	1.38
10	...	...	0.98	1.10	.93	.98	0.90	.99
11	...	...	...	0.83	.81	.81	.73	.69
11½	...	...	...	...	.61	.69	.65	.61
12	...	...	...	...	...	.57	.57	.59
12½	...	...	...	...	...	...	.49	.39
13¼	...	...	...	...	...	...	...	.18

Operation

The digester was filled full of wood for each cook. The actual weight of wood used in each cook is shown in the tabulation in Fig. 2.

After charging with wood the head was bolted on without closing the blow-off valve, and live steam passed through the chips from the top for half an hour. Studies of the moisture content of wood at various temperatures and humidities by the kiln drying section of the Forest Products Laboratory have shown that under the conditions of steaming the wood approaches a constant moisture content of 22 per cent when at equilibrium. This figure was used in all calculations in which volume of digester content was a variable.

When the steaming was completed the blow-off valve was closed and the acid run in immediately until the digester was completely filled. It was then allowed to stand over night. When starting the cook on the following morning, enough acid was run in to make up for the amount that had soaked into the chips over night, and completely fill the digester again. The quantities used are shown in Fig. 2.

The heating was carried out entirely with indirect steam by means of the coil. The temperature was raised to one hundred degrees centigrade in three hours, one hundred and forty-five degrees centigrade in eight and one-half hours, and held at that point to the finish. The pressure was not allowed to exceed sixty-five pounds per square inch. All cooks were made following the same temperature curve, and the premature blows were made at all the intervals at which samples were drawn, except the fourth hour.

During the cooks samples of liquor were drawn at the 4th, 7th, 9th, 10th, 11th, 11½, 12th, 12½ and 13¼ hours, and the analytical data are from the examination of these samples. The data from which the curves were drawn are averages of all analytical results. The contents of the relief receiver and of the gas-absorbing tank were also examined at the end of each cook.

The pulp from the seven-hour cook was not run into a sheet, as it was but little different from wood. The pulp from the nine-hour cook was beaten for an hour before running over the paper machine. This was necessary to make it screenable through .012 plates. In all the other cooks the pulp was taken from the blow pit, screened through .016 plates, run over a small wet machine and sampled for analysis, yield, bleach, and ball mill strength tests.

Materials

The wood used in this series of cooks was white spruce, cut near Rib Lake in northern Wisconsin during July or August, 1921. After barking and chipping to chips ⅝ths of an inch long it was sorted by hand and oversize and sawdust that passed a quarter inch screen removed; the knots were also removed.

The acid was made using a commercial hydrated lime prepared for chemical manufacturing purposes, and containing 98 per cent calcium hydrate. Sulphur dioxide from cylinders of liquid sulphur dioxide was passed into a suspension of the hydrate until the desired strength of acid was obtained.

---

[1]Chemist in Forest Products, U. S. Dept. of Agriculture, Forest Service, Madison, Wis.

[2]Assistant Wood Technologist, U. S. Dept. of Agriculture, Forest Service, Madison, Wis.

[3]Work directed toward a similar end is reported by A. Chambovet in Papeterie XL, May 25, 1919, et seq. trans. in Paper XXVII., Jan. 26, 1921, et seq.

FIG. 2—COOKING DATA AND PHYSICAL TESTS

Cook No.	Date 1922	Lbs. chips B. D.	Gals. H_2O in chips	Gals. acid	Gals. cooking liquor per 100 lb. B. D. wood	Max. temp. °C.	Time to max. temp. hrs.	Cook duration hrs.	Total SO_2	Free SO_2	Combined SO_2	Yield of unscreened pulp %	Screenings %	Yield of screened pulp %	Bleach %
630-I.....	2- 1	101.6	3.40	59.5	61.9	133	7	7	3.78	2.37	1.41	80.8	Not screened	80.8	Not bleached
629-I.....	1-31	97.5	3.30	57.0	62.2	145	8½	9	3.82	2.42	1.40	62.8	Not screened	62.8	Not bleached
626-I.....	1-21	90.6	3.08	55.0	64.9	145	8½	10	3.74	2.36	1.38	64.0	0.7	63.3	30
625-I.....	1-12	92.3	3.18	57.0	65.1	145	8½	11	3.81	2.40	1.41	51.0	0.7	50.3	30
634-I.....	2-14	98.9	3.33	57.0	61.0	145	8½	11½	3.80	2.38	1.42	50.58	1.08	49.5	30
633-I.....	2-10	99.0	3.36	57.5	61.5	145	8½	12	3.79	2.39	1.40	51.2	0.0	51.2	30
631-I.....	2- 3	102.0	3.48	56.5	58.8	145	8½	12¼	3.82	2.42	1.40	51.6	1.2	50.4	30
632-I.....	2- 8	95.9	3.24	58.25	64.1	145	8½	13¼	3.82	2.41	1.41	47.05	0.75	46.3	30
636-I.....	3- 7	88.3	3.28	58.5	70.0	137	15	15	5.60	4.46	1.14	48.43	0.13	48.3	15

	Machine Run									Ball Mill				
Cook No.	Wgt. per ream lbs.	Mullen test lbs. sq. in.	Strg. factor points 1/10000"	Strg. factor pts., lb.	Breaking length meters	% stretch	Folds	Temp. °F.	% Humidity	Max strg. lbs. sq. in.	Time to max. strg. min.	Tear lbs.	Time to max. tear min.	Double folds	Time to maximum folds minutes
630-I....		Pulp, raw—not tested													
629-I....		Pulp, raw—not tested													
626-I....	56.6	32.2	0.69	0.57	5960	1.7	58	65	64.5	119	80	1.5	40	670	60
625-I....	51.9	46.8	1.09	0.90	6410	2.1	389	69	65	109	60	2.3	40	1,030	40
634-I....	51.0	36.1	0.99	0.72	6030	2.7	271	66	65.5	99	60	1.8	20	739	40
633-I....	47.0	35.9	1.01	0.76	5450	2.1	426	71	65	109	60	2.2	40	700	60
631-I....	46.0	28.5	0.84	0.62	5830	1.8	223	81	65	98	60	1.9	40	910	80
632-I....	48.1	34.9	0.95	0.72	5080	2.1	363	68	65	85	60	2.5	80	1,500	40
636-I....	53.8	40.0	0.88	0.74	6120	2.5	283	70	65	95	60	1.8	20	1,220	40

The acid used had about the following composition in all cooks: 3.80 per cent total SO_2, 2.40 per cent free SO_2, and 1.40 per cent combined SO_2. See Fig. 2.

Analytical Data

The analytical data obtained on the liquor at intervals during the cook and upon the pulp produced in each cook include the following:

Total, free and combined sulphur dioxide by adaptation of the method of A. Sander.[4]

Total sulphur dioxide by iodine titration.

Loosely combined or reversible sulphur dioxide according to Klason.[5]

Lignin in the pulp.

Total calcium.

Ash in pulp.

Cellulose in the pulp.

Total, free and combined sulphur dioxide are used in their usual significance. The determination will be taken up again in the discussion of results.

Total sulphur dioxide by iodine titration was carried out in the usual manner, using N/16 iodine solution with starch indicator.

In carrying out the determination of loosely combined sulphur dioxide according to Klason, the solution was allowed to stand half an hour in all cases before completing the titration.

Lignin in the pulp was determined as matter insoluble in 72 per cent sulphuric acid, according to the method of Konig and Rump[6] used in this laboratory.

Total calcium in the liquor was determined by fuming a sample with nitric and sulphuric acids until a pale yellow solution was obtained that did not darken when heated to the point at which fumes of sulphur trioxide were given off. In the solution obtained after dilution the calcium was precipitated as calcium oxalate and after filtering, the precipitate was dissolved and the oxalic acid titrated with permanganate solution.

The ash was obtained by ashing a quantity of the pulp in porcelain in electric furnace.

Cellulose in the pulp was carried out according to the Cross and Bevan[7] method in use in this laboratory.

The table, Fig. 2, includes the data covering the yield, cooking data and tests of strength by the ball mill method.

In the curves of analytical data the results are in all cases expressed in terms of grams of the material determined in the total digester contents, except that for lignin, which is in terms of per cent of the lignin content of the wood that had been removed. To obtain these figures the amount of liquor withdrawn in sampling and the amount of liquor in the relief receiver at the time of sampling were deducted from the original quantity of liquor in the digester and the analytical results calculated to the corrected volume.

In the case of the calculated results, that for inorganic combined calcium is calculated from the combined sulphur dioxide determined by the Sander method, and the organic combined calcium is the difference between the total and the inorganic combined calcium.

Organic combined sulphur dioxide is that which remains when from the amount of sulphur dioxide present at the beginning of the cook there is deducted the sulphur dioxide in the gas-absorbing tank, that in the condensed relief receiver, that in the samples withdrawn, the loosely combined sulphur dioxide, and the sulphur dioxide titrable with iodine at the end of the cook. In other words, all sulphur dioxide not determined in some other form is calculated as organic combined sulphur.

The Sander reaction or method for determining the SO_2 content of a cooking liquor as used in this study is an adaptation of that described by A. Sander in a recent publication.[8] Several series of titrations were run, comparing the analytical method based on the Sander reaction with the Winkler method of titrating with iodine and alkali, using phenolphthalein as indicator as commonly used in the testing of cooking liquors in mill operation. For the comparison a solution of calcium bisulphite and sulphurous acid made from pure chemicals was analyzed by both methods, and also by evolution of sulphur dioxide and precipitation of calcium, as calcium ovalate and titration of the dissolved precipitate with standard potassium permanganate solution. It was found that the two methods gave the following results using CO_2 free soda solution:

Comparative Results

Evolution and precipitation		Winkler Average of 6 trials	Sander Average of 6 trials
Total SO_2	4.39	4.39	4.30
Free SO_2	3.04	3.03	3.02
Combined SO_2	1.35	1.36	1.28

It was also noted that the presence of CO_2 in the titrating solution or the cooking liquor, while it had an appreciable effect on the titration by the Winkler method, using phenolphthalein indicator, was without effect on that by the Sander method when in the concentrations likely to be encountered in technical work in the mill laboratories.

When applied to the titration of the liquor at intervals during the cook the method of Winkler is of no value, as has long been known. The error in the alkali titration by the Winkler method has been attributed to the presence of organic acids which caused the value for free SO_2 by alkali titration to exceed the value for total SO_2 by the iodine titration in the later stages of the cook. No measure of the combined SO_2 was possible, therefore. The application of the Sander reaction, however, makes it possible to measure the concentration of combined SO_2 at all stages of the cook.

Application of Sander Method

The Sander reaction as used in these studies is applied as follows: A two cubic centimeter sample of the liquor, either fresh cooking liquor or liquor drawn from the digester, is diluted to about one hundred cubic centimeters with distilled water, and titrated with N/8 sodium hydroxide solution, using methyl orange as the indicator. When neutral, according to the change in methyl orange, an excess of a saturated solution of mercuric chloride is added upon which the contents of the titrating flask become acid again. Titration is then continued

[4]Paper Trade Journal, LXXXI., No. 10, Sept., 1920.

[5]Paper, Volume 23, No. 13.

[6]Jour. Ind. and Eng. Chem. 9, page 566 (1917).

[7]Jour. Ind. & Eng. Chem. 9, page 556 (1917).

[8]Loc. cit.

until once more neutral to methyl orange. Four times the second titration gives the per cent total SO_2. Twice the difference between the second and first gives the per cent combined SO_2.

In the first titration all the SO_2 present as excess sulphurous acid is converted to bisulphite, so that all SO_2 present in the solution when the first neutral point is reached is in the form of bisulphite. The addition of mercuric chloride to this solution brings about the formation of a complex addition product to which A. Sander assigns the formula.

$Ca(HgCl\ SO_3)_2$, and liberates one molecule of hydrochloric acid for each (HSO_3) ion present.

The reactions are as follows:

First titration—

$H_2SO_3 + Ca(HSO_3)_2 + NaOH \rightarrow NaHSO_3 + Ca(HSO_3)_2 + H_2O$. Addition of $HgCl_2$.

$NaHSO_3 + Ca(HSO_3)_2 + 3HgCl_2 \rightarrow NaHgClSO_3 + HCl + Ca(HgClSO_3)_2 + 2HCl$.

This liberated hydrochloric acid is titrated in the second titration and is an indirect measure of the total SO_2 present. The difference between the first and second titrations is a measure of the amount of bisulphite originally present in the solution and, therefore, an indirect measure of the combined SO_2. The difference between the total and combined then gives the value for free SO_2.

It was discovered early in the study that there was a discrepancy in the concentration of total SO_2 as measured by the two methods in the cooking liquor at different stages in the cook. The total by the iodine titration (see Fig. 3) being invariably lower than that by the Sander method, but in varying amount. Consideration of the loosely combined or reversible SO_2 content of the liquor suggested a connection that was tested as follows:

In the ordinary determination of reversible SO_2 after titration with iodine, decolorizing and making alkaline, the solution was allowed to stand half an hour before acidifying and titrating the reversible SO_2. It was found that if the solution without previous titration with iodine was made alkaline, allowed to stand half an hour, and then acidified and titrated with iodine, the value obtained was equal to the sum of the total SO_2 and reversible SO_2 obtained by the ordinary manipulation. Also, if the solution was titrated with alkali to neutrality, using phenolphthalein as the indicator, and then acidified with HCl and titrated with iodine, the value for SO_2 obtained approached the sum of the total SO_2 and reversible SO_2 by the ordinary manipulation. It appears then that the titration with alkali determines not only the free SO_2 but the reversible SO_2 in part also, and the more slowly the titration is carried out the more completely the reversible SO_2 is split off and titrated.

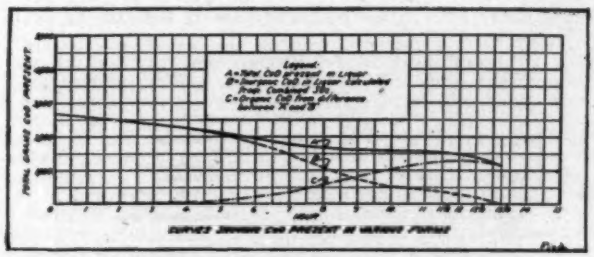


Figure 4

The following table shows the relations discussed and are taken from the control analyses of a recent cook:

RELATIONS BETWEEN ALKALI TITRATION, IODINE TITRATION AND REVERSIBLE SO_2

Hours	Sander Method: Comb. %	Sander Method: Free %	Sander Method: Total %	Sum of iodine total and reversible SO_2 %	Iodine, total %	Reversible SO_2 %
4	1.02	3.42	4.44	4.46	4.36	0.10
7	.65	3.20	3.85	3.87	3.62	0.25
9	.58	3.02	3.60	3.40	3.18	0.32
10½	.34	2.62	2.96	2.98	2.64	0.34
11½	.30	1.86	2.16	2.07	1.71	0.36
12	.14	.74	.88	.91	0.45	0.46
12¼	.10	.54	.64	.61	0.21	0.40

The values for the alkali titration in the Sander method when applied to samples from the digester then are too high by an amount approaching the reversible SO_2 content of the liquor. This, however, does not introduce an error into the determination of combined SO_2 because the same error is present in both titrations by the Sander method and the value for combined SO_2 being derived from the difference between the two is unaffected.

The true values for the concentration of SO_2 in its various forms of combination are obtained by taking the iodine titration as a measure of the total SO_2,* the combined SO_2 by the Sander method as the measure of the combined SO_2 and the difference between them as the true free SO_2. These values are those from which the curves in Fig. 7 were drawn.

The test of physical properties of the pulps produced in

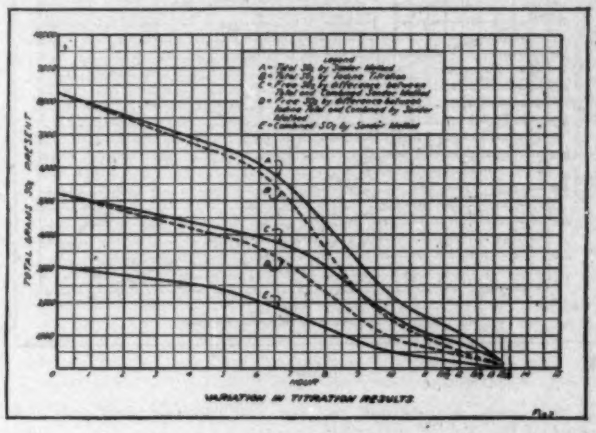


Figure 3

these cooks are shown in table, Fig. 2, together with the data on acid strength and quantity, and amount and condition of the wood used in each cook.

The cook blown at the seventh hour was in no sense pulp. While there was much evidence of cooking action in that the wood was lighter in color and somewhat softened, the chips were not disintegrated. That blown at the ninth hour was much disintegrated and the chips had lost their form. It was not screenable, however, and required some beating before it could be run into a sheet. That blown at the tenth hour was pulp and the disintegration had proceeded so far that the pulp could be screened and run into a sheet. The pulp at this hour was the strongest produced in the series, being equal in strength to good Mitscherlich pulp. It was not of good color, however, and the sheet while strong had a harsh appearance and feel.

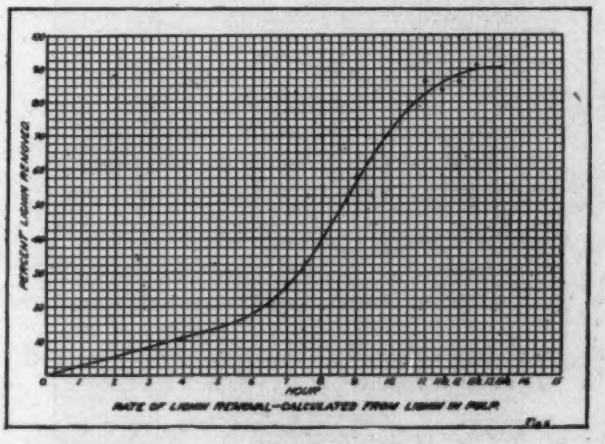


Figure 6

The cook blown at the eleventh hour was the best of the series in point of color, approaching but not equaling the color of good commercial sulphite. In point of strength it was but little inferior to the cook blown at the tenth hour and much

*Klason in "Beitrage Zur Kenntniss der Chemischen Zusammensetzung der Fichtenholz" (Contribution to the Knowledge of the Chemical Composition of Spruce Wood). Notes that one molecule of SO_2 is so loosely combined with organic matter that it may be partially titrated with iodine at ordinary temperatures. This accounts for the irregular end point in titrating liquor at the end of the cook.

superior to it in general appearance and feel. The cooks from the eleventh hour on were irregular in color and inferior in all respects to the one blown at the eleventh hour, culminating in the cook blown in thirteen and one-quarter hours, which was burned and decidedly an inferior product. The cook blown in twelve hours has a maximum strength equal to the one blown in eleven hours, but this maximum is a peak

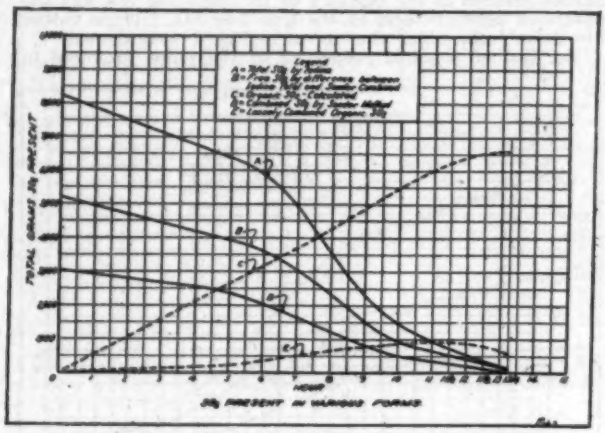


Figure 7

in the curve maintained for but one reading, and was not checked for lack of material.

In considering the analytical data in the light of the pulp produced the most outstanding feature is that the marked change in the chemical composition of the liquor ceased at or about the same time that the pulp of most superior quality was produced, and at the same time the marked change in chemical composition of the pulp ceased. In general, the action after the eleventh hour was to the detriment of the pulp. The conclusion to be drawn is that for this strength of acid and the temperature and pressure employed the cooking was complete at some instant at or about the eleventh hour.

The results of the study of the location or state of combination of the base, Fig. 4, present some interesting features. The rate of change in the curves representing both the amount and concentration of base present in inorganic combination decreases markedly at or about the same time that the pulp

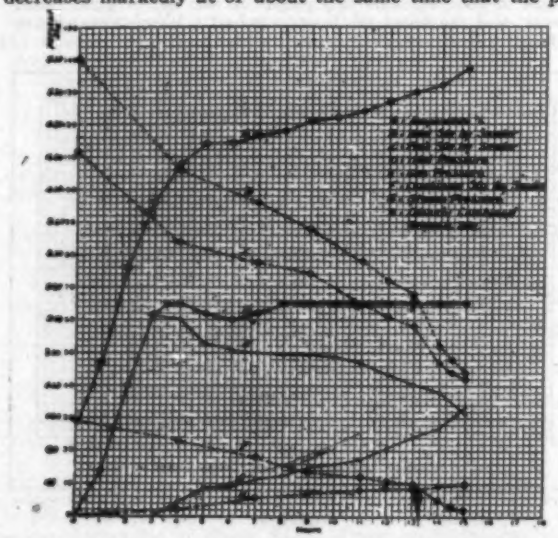


FIG. 9

reaches its maximum quality. Only by blowing gas vigorously as was done in the cook blown at thirteen and one-quarter hours was it possible to greatly reduce the amount of inorganic combined base. The reaction involving combination of base, then, ceased at or about the same time that the pulp was at its best.

The curve representing the total base present in the solution follows a downward course to an approximate level, but its conformation does not appear to be related to the nature of the pulp. That it should decline at all may occasion surprise, as there was only a small amount leaving the digester in the relief. That it does decline leads to the conclusion that it must be localized in some manner such that it is removed from the liquor of which the sample drawn is representative. Such removal can be understood if it is assumed that it is in some way attached to or collected around the fibers and an examination[10] of the pulp ash confirms this assumption.

ASH CONTENT OF PULP

Hour	7	9	10	11	11½	12	12½	12¼
% Ash	2.17	2.71	2.12	1.08	1.21	1.08	1.00	1.95
% CaO	1.25	1.17	0.74	0.35	0.38	0.34	0.26	0.64

ASH CONTENT OF PAPERS

Hour	11½	12	12½	13¼
% Ash	0.67	0.80	0.74	1.04
% CaO	0.22	0.25	0.22	0.29

Whether or not it is combined with or absorbed onto or precipitated upon the fibers has not been proved, but examination of the analytical data indicates that it is precipitation in part at least. If it were combined with the fiber or undissolved organic matter still attached to the fiber, a greater regularity of ash content would be expected, and further, the operation of running the sheet of paper should not remove it, as is indicated by comparison of the ash content of the pulp and the paper made from it. The base unaccounted for is probably deposited on the heating coils or lost in washing the pulp (table, Fig. 5).

FIG. 5. LOCATION OF BASE

Cook No.	630-I	629-I	626-I	625-I	634-I	633-I	631-I	632-I
Total added CaO grams	2,768	2,675	2,518	2,715	2,680	2,662	2,621	2,700
CaO found in liquor grams	1,727	1,562	1,568	1,437	1,586	1,482	1,592	1,150
CaO found in pulp grams	421	334	214	82	87	78	61	136
CaO unaccounted for grams	620	780	737	1,197	1,007	1,103	969	1,414

The curve for organic combined base is obtained by sub-

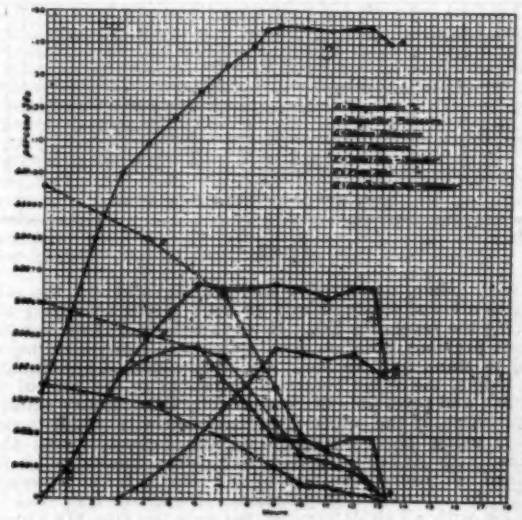


Figure 8

tracting the inorganic combined base calculated from the combined SO_3 from the total base determined in the liquor and shows again that after the eleventh hour no further appreciable amount of combination of base takes place.

The curve for the rate of removal of lignin, Fig. 6, is interesting in that it throws a somewhat different light on the common view of the course of this fundamental action. The view is commonly held that the cooking action takes place in greatest amount near the end of the cook. The data upon which the curve is based, however, show that the action that removes the lignin has made some progress before the fourth hour and 110° C. has been reached, attains a considerable speed at temperatures but little above one hundred degrees Centigrade, and proceeds with vigor through all temperatures that are commonly thought of as intermediate. It will be noted also that at the point at which the best pulp was obtained there is a slackening of the action and that after the eleventh hour the irregularity of the data does not justify any conclusion that lignin removing action took place. The decreased rate of reaction will be discussed later in this paper. It is noteworthy

[10]Similar work by Dr. C. G. Schwalbe—Zell u. Papier, i, 11 (1921).

also that at the eleventh hour, the hour at which the best pulp was obtained, the lignin content is in close agreement with the lignin content of strong Mitscherlich pulp, viz., 7.56 per cent. See table, Fig. 10.

The curves representing the amount of sulphur dioxide present in various states of combination are given in Fig. 7. The curves in Fig. 8 represent the concentration of total, free, and combined SO_2 as determined by the Sander method, and also the temperatures and pressures during the cook. Fig. 8 is in fact a reproduction of the cooking record of the cook blown at thirteen and one-quarter hours.

In these curves the approach to a constant value is not as close as in the case of the curves previously discussed, but it should be remembered that the values for sulphur dioxide are being changed by the relief. They do, however, show a marked change in rate of variation, and allowing for the effect of relief the approach to a constant value is near enough to suggest that in the case of the total, free and combined sulphur dioxide there is little pulping action in which they are concerned after the eleventh hour.

The curve for the loosely combined sulphur dioxide values shows decline after reaching a maximum at eleven and one-half hours, suggesting a decomposition and liberation of SO_2 in the later stages of the cook.

The curve representing the organic combined sulphur shows a rapid increase over the same periods during which a rapid removal of lignin was taking place, but unlike the other values it does not reach an approximately maximum until the end of the cook. This suggests that while the action which removes the lignin from the wood may come to a stop at or about the eleventh hour, the reaction of sulfonation may continue upon the lignin already removed.

ANALYSIS OF PULPS

Cook No....	630	629	626	625	634	633	631	632	636
Cellulose %.	62.0	73.10	76.95	85.77	87.38	87.97	92.60	89.92	94.35
Lignin %...	25.85	16.55	16.55	7.56	9.11	7.36	5.06	6.28	1.76

The cellulose and lignin content of the pulps produced at the various intervals is shown in the above table (Fig. 9).[11] It will be noted that there is relatively little change in the composition of the pulp and a tendency toward irregularity after the eleventh hour. That the change should be of the order shown is further confirmation of the conclusion that there is little cooking action after the eleventh hour, and that the action which does take place has a tendency to injure the pulp and may be entirely secondary to the real cooking action.

The carrying out of this preliminary series of cooks has demonstrated the value of two reactions as indicators of the progress of the cook, viz., the Sander reaction and the loosely combined SO_2 determination.

The Sander reaction or method gives for the first time a convenient method for determining the rate of exhaustion of the cooking acid at all times in the cook, giving as it does close measure of the concentration of combined sulphur dioxide. It indicates with certainty the approach of the time when a digester must be blown to avoid burning. Taken in connection with the iodine titration, it gives a true measure of the concentration of total, free and combined sulphur dioxide.

The amount of loosely combined sulphur dioxide has a close connection with the rate of solution of that material described as lignin. Bearing as it does a close relation to the difference between the total sulphur dioxide as determined by the Sander method and iodine titration, its approximate value can be quickly determined. The numerical value of the determination is of less importance than its rate of change. When the value becomes constant, it does not indicate that good pulp will be obtained on blowing, but it does show that the point has been reached beyond which further cooking will not greatly improve the pulp.

The application of these reactions in the mill will be of less value as control methods than as means of determining the location of defects in cooking method, but in this latter connection they should be of great value.

Considering the series and associated analytical data as a whole, the general impression or broad conclusion is that under the conditions of the series, a pulp that would be equivalent in all respects to commercial pulp could not be made. The question arises, "In what respect was the combination of temperature, pressure, acid strength, acid composition at fault?" That it is the combination is readily understood when it is considered that no one factor considered alone is responsible for the shortcomings of the pulp.

If the data be examined, one is at once struck by the abrupt change in the rate of reaction at about the eleventh hour. Conditions prevailing just before and just after are not very different, yet the rate of change is much different. The analytical data on the pulps, Fig. 9, show that while the removal of lignin nearly ceases at the eleventh hour, yet a pulp of high purity has not been produced. Commercial pulps of good quality will give about 94 per cent cellulose with a lignin content of 5 to 7 per cent.

FIGURE 10

ANALYSIS OF COMMERCIAL PULPS

Sample No.	Lignin %	Cellulose %
S 31	6.19	94.23
S 33	7.04	94.60
S 34	5.17	95.30

From this information it was concluded that the acid strength and composition after the eleventh hour were not capable of maintaining the reaction, either because of the residual materials being more difficult to remove or because of the completion of the reaction that the acid of the then composition and strength was capable of maintaining, or because the decrease in amount of material to be removed brought about an apparent stoppage of the reaction. That the reaction that had stopped was not sulfonation was suggested by the continued rise in the curve for organic combined sulphur. The action of hydrolysis remains, and to determine if making the conditions for continued hydrolysis more favorable would produce a pulp with purer cellulose and better color and greater bleachability, a supplementary cook was made. In this cook the acid composition was: Total, 5.60 per cent; free, 4.46 per cent, and combined, 1.14 per cent. The increase in free was to increase the possibility of hydrolytic reaction. To maintain, therefore, the advantage of a high free SO_2 content, a temperature curve was selected such that there would be little necessity for relief and consequent exhausting of the acid when a maximum pressure of sixty-five pounds per square inch was maintained. This curve called for a rise to one hundred degrees centigrade in three hours and a rise not exceeding three degrees an hour thereafter—curve, Fig. 11. Decision to blow was based on: 1. The Sander reaction showing a very low concentration of combined SO_2. 2. The loosely combined sulphur reaction showing that a maximum value had been reached. 3. The color of the liquor, which was that of a liquor from a well cooked commercial cook. The cook was blown after fifteen hours at a maximum temperature of one hundred and thirty-seven degrees centigrade. The data on the pulp produced is that for cook 636-I, and it will be noted that the cellulose content has increased, the lignin content has decreased, the pulp is much more readily bleachable and the strength is but little impaired. The color also was excellent. Its cellulose and lignin content compare favorably with an easy bleaching Mitscherlich pulp of commercial origin, viz., cellulose 96.05 per cent, lignin 1.62 per cent.

The success of this experiment seems to justify the conclusion that while sulfonation may be an essential part of the reaction or reactions producing pulp from wood by the sulphite process, it is of greater importance from the standpoint of the commercial value of the pulp to maintain at the finish of the cook conditions favorable to hydrolytic reactions, namely, a high concentration of free sulphurous acid.

Summary

1. A method of procedure for the study of the chemistry of the sulphite process has been tested and found to be workable.
2. Methods of analysis have been tested and applied to the preliminary study.
3. The application of two hitherto little used methods, the Sander reaction and reversible sulphur dioxide determination, to the control of a sulphite cook have been tested and found of value.
4. Information as to the character of pulp produced at different stages in a sulphite cook has been secured.
5. The importance of the content of free sulphurous acid at the end of the cook has been pointed out.

Some Factors Influencing Yield and Strength of Pulp Cooked by the Soda Process

By Martin L. Griffin

SOME improvements have been made in the soda process from time to time to increase the yield and thereby the strength, the most important of which have been the careful sizing of the chips, shortening of the cooking time and the systematic rotation of the digesters. No improvements have been made in the manner of charging the digester, the circulation or the control of the process.

Conditions Which Tend to Weaken Pulp

There are still some matters in this connection which I suppose are not well known, and it is easy to understand why they have not been realized, and yet it seems to me have been overlooked too long. I have in mind those influencing the con-

[11] Data on composition of pulps supplied by M. W. Bray of this laboratory being part of data to appear later in publication of results of the Study of the Chemistry of Pulps by M. W. Bray and others.

ditions which tend to weaken the strength of the pulp and consequently degrade its value and yield.

When I call to your minds the similarity of the process in cotton textile finishing with that of reducing wood to finished pulp by the soda process, you will realize better the similarity of many of the chemical problems.

Cotton fabrics from the loom are boiled usually in high pressure kiers with alkalies to remove the impurities contained in the cotton and the sizing used in their manufacture. The cloth is washed and then bleached or "chemicked," as it is called in this industry. Wood is reduced to finished pulp in essentially the same way.

Conditions Very Exacting

The conditions imposed upon the process of bleaching and chemicking the cloth are very exacting and failure to recognize them would result disastrously. The cloth must not be tendered or oxidized. If it is tendered, its value is destroyed; if it is oxidized, it will not dye level and this is fatal. These defects require no deep investigation to prove their existence. They come out in the processes. Not so in the case of pulp unless the defects are glaring. It is not easy to discover small differences in the strength and yield of pulp.

So far as I know, no one has brought forth any forecast as to whether the part of the chips and pulp in a digester at all times submerged in the liquor and that part which may be exposed to an atmosphere of steam at the top are any different at the end of the operation. It would be difficult to discover.

Must Be Submerged at All Times

In bleaching cloth in kiers, we have ready means and absolute proof to show that cloth must be submerged or wet in the liquor at all times to avoid tendering, any part of which, if exposed to an atmosphere of dry steam, is pretty sure to be tendered. This is common knowledge with all the cotton finishers. This same truth is well known to those acquainted with the sulphite process, where failure to submerge the chips in the liquor is bad practice and where slight differences in the residual sulphurous acid at the end of the cook affects the strength, yield and bleaching qualities to a marked degree.

Efforts to Increase Yield

It has long been assumed that soda pulp is necessarily short and without much strength, and the effort to improve and get the yield out of the process has been limited for the most part to shortening the time of cooking. It is well known that the sulphite and sulphate processes will give a much larger yield of well cooked, easy bleaching pulp than the soda process, from the same woods. What is the explanation?

To my mind, the reason lies in the fact that the sulphite process and the sulphate process are deoxidizing and therefore act to preserve the strength and increase the yield. The question naturally arises why the old type of soda process should persist or why, if so, means should not be resorted to to correct these defects. Means have been brought forward in some measure which will overcome them, but little heed has been given them.

Some years ago Joseph E. Hedin, a member of our association and then manager of the Delaware Mills of the Jessup & Moore Paper Company, discovered that the yield of soda pulp was increased by three to five per cent by the addition of small quantities of sulphur to the cooking liquor and a patent was granted to him therefore.

I myself conducted a series of experiments later, using increasingly small quantities of sulphur, proving conclusively that the yield was increased accordingly as the amount of sulphur was increased. This is due, of course, to the fact that sulphur is a strong deoxidizing agent.

In 1920 my colleague, Mr. Spence, presented a paper on the "Use of Sulphur in Cooking Soda Pulp," having reference to its influence on the amount of bleach required but with no reference to its effects on yield.

Knowing as I do the evil and dangerous effects of boiling cotton fabrics in high pressure kiers if at all exposed to an atmosphere of steam, I feel very sure that the common practice of cooking wood by the soda process, in which a considerable proportion of the chips and pulp are more or less exposed to an atmosphere of high pressure steam, is detrimental to the quality and yield of the pulp. For many years I have had strong convictions regarding the importance of a free circulation of the cooking liquor and the advantages of relatively low temperatures. These convictions have been amply sustained by my late experiences.

To those who have been engaged only with cooking wood, which is the most resistant of all raw materials for paper, these baneful effects will not be so apparent, but to those who are experienced in reducing jute, hemp and esparto, the necessity for a very discriminating treatment will be evident.

In cotton finishing the injector circulating system was a common practice, but today this type has been very largely replaced by a positive pump circulation in which the liquor and the cloth fill the entire space and the kier may be circulated in either direction. As I have said before, the evil or beneficial effects in treating cloth are very apparent and I am satisfied are a sure indication of the mode of treatment which should be employed in cooking wood pulp.

A system which will prevent oxidation either by the use of a deoxidizing solution or by a circulating system which will cover or submerge and penetrate all parts of the mass alike and avoid as far as possible high temperatures will surely enlarge the yield and improve the quality of the product.

To my mind there is no system so effective as a positive pump, so arranged that the liquor may be circulated in either direction. The upward circulation is very buoyant and free, whereas the downward direction tends to pack. Both directions, downward by the soda process and upward by the sulphite, are common in cooking pulp, but they "lack the pep" of the positive pump. The obstacles to using a pump for positive upward circulation are slight compared to the great advantages and as applied to the sulphite process of cooking would show astonishing results.

I have fully realized in the past how difficult it is for the mill chemist to initiate reforms in his own domain, but I hope that there are chemists here today with knowledge, experience and personally capable of putting through some of these fundamental principles which I have tried to present convincingly.

Contribution to the Knowledge of the Constitution of Spruce Wood Lignin*

By Dr. Peter Klason

THAT part of the lignin, which contains a sulphite acrolein group and the lignosulphonic acid of which gives cyclic aryl ammonium salts, is in this paper called *acrolein-lignin* or *α-lignin*. It is identical with the calcium lignosulphonate that can be precipitated by $CaCl_2$. But also one other lignin is found in the wood.

Its calcium sulphonate is not precipitated by $CaCl_2$, it gives no cyclic salt, but it contains one carboxyl complex. I therefore here call it *carboxyl-lignin* or *β-lignin*.

1. Acrolein-lignin (α-lignin), $C_{20}H_{22}O_7$.

As I have shown in my previous paper[1], the acrolein complex found in the spruce wood must be present as coniferyl aldehyde.

This, however, represents only about one-half of the α-lignin molecule. It might probably be rather difficult at the present status of organic chemistry to get a definite clue to the constitution of the other half of the lignin molecule if one can not find a fixed point in some known relations. It seems as if we could find this in the observation that the waste liquor from the sulphite digestion of pure wood is clear golden yellow, and when the color is not very strong, it is a little stronger in reflected light. It is impossible to decolorize the solution to any degree by means of animal charcoal. The color is weakened somewhat by zinc dust in alkaline solution, but exposed to the air it regains its previous strength rapidly. It consequently seems as if the acid contains a cromophore group.

Now several yellow dyes exist in the vegetable world, which are present dissolved as glucosides in the sap or imbibed in the cell walls of the wood. They contain all a nucleus of quinoid structure, a γ-pyron ring.

In most cases this pyron is combined with a benzene nucleus to the mother substance chromon, and this finally combines with phenyl to a phenylchromon which has been named flavon. Flavon or its hydroxyl derivative flavonol is the original substance of several yellow dyestuffs existing in nature, e.g. quercitin (in quercitron).

First we therefore have to investigate how far known facts in harmony with the assumption of flavon or flavonol as the original substance for the lignin.

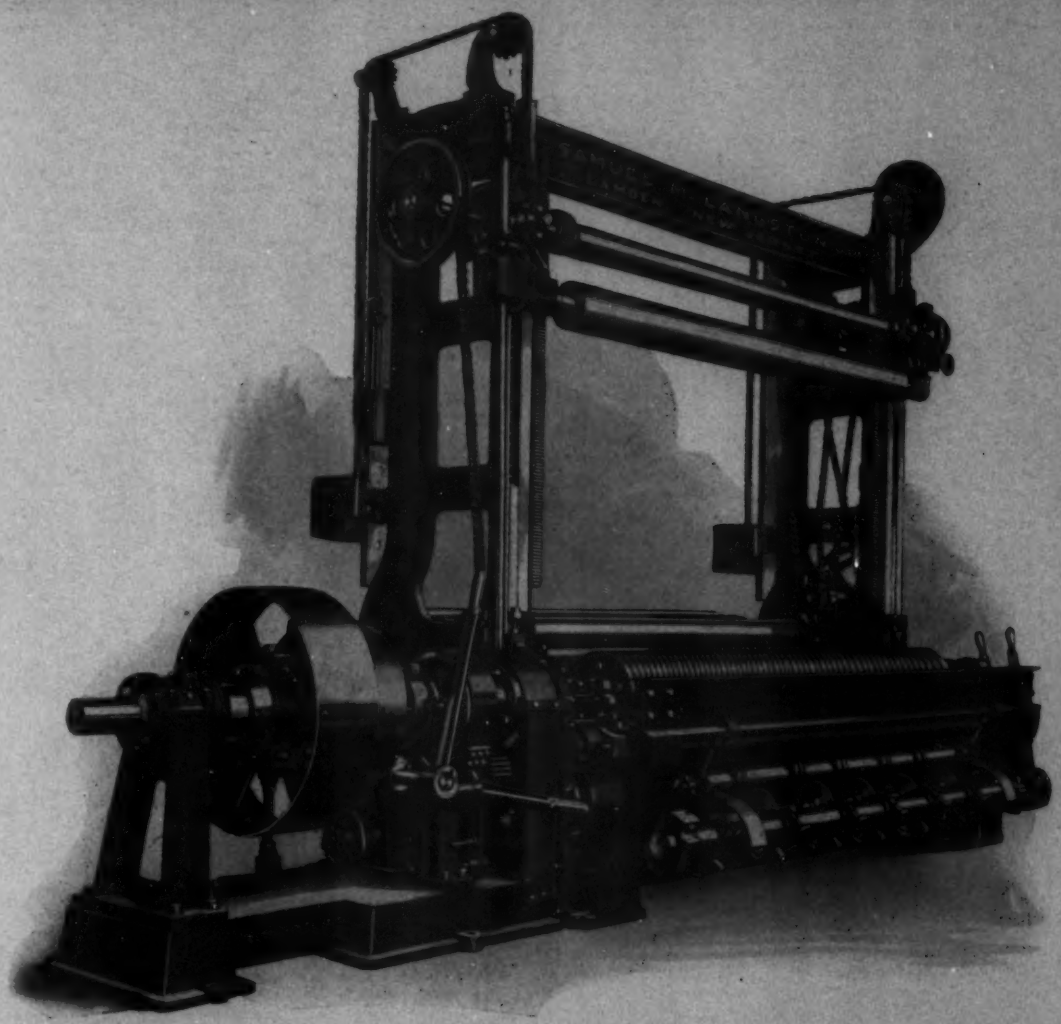
By precipitation in concentrated waste liquor with calcium chloride I[2] could throw down about one-half of the calcium ligno-sulphonates existing in the liquor. After purification they showed the following composition:

---

*A translation, with the special permission of the author, of a "Sonderabdruck," from the Berichte der deutschen Chemischen Gesellschaft, which he sent to the translators, W. E. Byron Baker and Carl L. Fineman. The translation is exclusively for publication in Technical Association Papers.

[1]Ber. 53, 706 (1920).

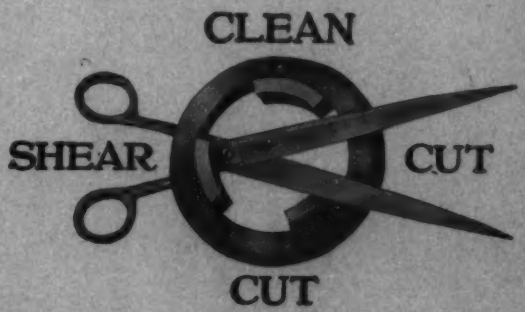
[2]Arkiv. f. Kemi 3, No. 5; Sv. Kem. Tidskr. 1917, 8.



The Langston "DA" Slitter and Winder or Rewinder

Shear Cut Means Dustless Rolls
Surface Wind Means Hard Rolls Any Diameter
Balanced Rolls and Shafts with Ball and Roller Bearings Means High Speed
Heavy Construction Means Long Life

Samuel M. Langston Co.
Camden, N. J.

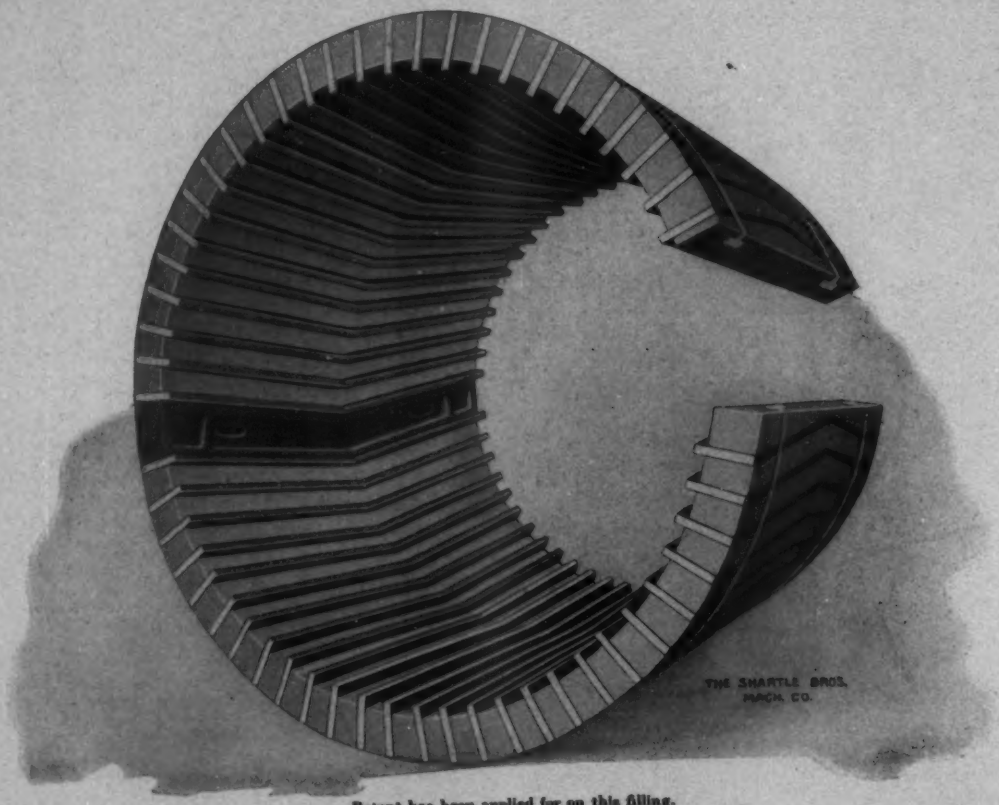


AGENTS

T. W. & C. B. Sheridan Co., London, England

Toronto Type Foundry Co., Toronto, Canada

SHARTLE
Bulldog Shell Filling



Patent has been applied for on this filling.
If granted, all infringements will be vigorously prosecuted

Will not tear out
Is a wood and steel filling
Saves labor in installation
Has 15 per cent more knives than a cast filling

Always fits
Wears evenly
Made for any jordan
Will handle all kinds of stock
Made in Bronze, Ampco or Steel

Ship us your shell fillings and we will make them into Bulldog fillings

The Shartle Bros. Machine Co., Middletown, Ohio

	1	2	3
C	52.78	53.20	51.63
H	4.95	4.73	5.30
S	6.35	6.57	....
Ca	4.15	4.24	4.04
CH_3O	12.87	....	....

M. Hönig and J. Spitzer[3] some time ago prepared calcium and barium salts from the waste liquor in the following manner. The sulphonic acids were separated with mineral acids, the acids transformed into the salts mentioned and these latter fractionally precipitated with alcohol. If the composition of the Ba salts is calculated as Ca salts the 4 fractions gave the following figures in per cent:

	1	2	3	4
C	54.95	53.88	53.48	51.52
H	5.23	5.28	5.14	5.39
S	6.84	6.47	6.91	7.02
Ca	2.69	3.03	3.16	3.30
CH_3O	11.66	12.16	12.07	3.20

In conformity with my earlier observations,[4] their sulphonic acid could not be completely neutralized with barium carbonate. If the correction for this is introduced the result is the following:

	1	2	3	4
C	54.09	53.34	52.89	40.96
H	5.14	5.24	5.10	5.35
S	6.73	6.40	6.83	6.95
Ca	4.20	4.00	4.26	4.34
CH_3O	11.66	12.16	12.07	3.20

The first three fractions are, as the authors also state, fundamentally identical with my salt. The low figure for methoxyl in the last fraction is probably due to the splitting off of methyl alcohol or formic acid during the sulphite digestion.

The empirical formula which I[5] derived from my analysis was $C_{20}H_{21}O_{10}S_2Ca$. The degree of agreement with the average of their and my analyses may be seen from the following table:

		Calc.	Found
C_{20}	480	52.41	52.82
H_{44}	44	4.79	5.08
O_{18}	288	31.45	....
S_2	64	6.98	6.58
Ca	40	4.37	4.15
	916	100.00	
$4CH_3O$	124	13.53	12.19

The agreement is remarkably good, considering the fact that the figures have been obtained by different chemists on different liquors and that the analyzed substances are amorphous compounds with heavy molecules. One may therefore be entitled to assume that substantially the same material was present on both occasions.

The above mentioned formula $C_{20}H_{21}O_{10}S_2Ca$ corresponds to the lignin formula $C_{20}H_{22}O_{12}$. Since, as will be explained later, there is reason to cut this formula in half, the lignin must have either the formula $C_{20}H_{22}O_6$ or $C_{20}H_{22}O_5$. It is easy to see that the analyses alone cannot decide this. Because it agrees better with the composition of the lignin in the wood, I will here use $C_{20}H_{22}O_6$ as the empirical formula for the α-lignin in the calcium lignosulphonate.

Consequently the formula for the calcium lignosulphonate is $C_{20}H_{21}O_9SCa_{1/2}$.

		Calc.	Average found	Diff.
C_{20}	240	52.52	52.82	+0.30%
H_{21}	21	4.60	5.08	+0.46%
O_9	144	31.51	....	....
S	32	7.00	6.58	—0.42%
$Ca_{1/2}$	20	4.37	4.15	—0.22%

Moreover, disregarding that the calcium salt, even if it can be considered as a chemical individual, might not be present in pure form, it can retain some of the acetyl complex, the main part of which is split off during the cook, which will be mentioned several times more in the following.

It has been known for a long time that acetic and formic acids are formed during the sulphite digestion of fir wood.

In order to determine the quantity of acid 45 g. dry weight of pure spruce wood were cooked with sulphite cooking acid until all the lignin was extracted. 0.945 g. acetic acid was formed. The acetic acid was removed and the solution inverted by heating for 12 hours, acidified with sulphuric acid, on a waterbath. 0.21 g. acetic acid more was thereby obtained, therefore a total of 1.155 g. acid, about 10 per cent of which was formic acid. In the sense of the following, 45 g. wood corresponds to 8.5 g. α-lignin having the formula $C_{20}H_{22}O_7$. According to the calculation 398:60 = 8.5:1.28. 1.28 g. acetic acid should have been formed, assuming that the α-lignin in the wood contains one acetyl group which can be split off, and that must evidently really be the case.

A powder of spruce wood (37 g. dry weight) was treated with 400 cc. n-H_2SO_4 for 24 hours on a waterbath. The acid distilled off with steam corresponded to 130 cc. n/10 = 2.1 g. acetic acid for 100 g. wood. Alkali cannot be employed in this investigation because carbohydrates also give acetic acid with alkali.

Assuming that this complex is completely split off, the acetic acid formation corresponds to 2.86 per cent of the dry weight of the wood. Since almost the same quantity of acid is obtained from the lignin by the dry distillation of the wood, we find that the formation of the acid then depends upon the splitting off of the acetyl group by means of steam, helped along by the high temperature.

The acrolein lignin in the wood has consequently the composition $C_{20}H_{22}O_7$. The calcium sulphonate of this lignin is precipitated from its concentrated solution by calcium chloride though, of course, not completely. It is completely precipitated, however, by β-naphthylamine hydrochloride. It is consequently possible to separate completely the α-lignin from the β-lignin with this agent, as the above mentioned cyclic salt. An important part of this investigation is the determination of the ratio of the weights of the α-lignin and the β-lignin.

The lignin was completely extracted from 38.93 g. dry weight from an 80 years old spruce. Obtained: 10.5 g. cycle naphthylamine salt = 7.4 g. α-lignin of the formula $C_{20}H_{22}O_7$ = 19 per cent of the weight of the wood.

By means of sulphuric acid containing 70 per cent H_2SO_4, which does not dissolve even a trace of lignin I[6] have found about 28 per cent lignin in spruce wood. Hägglund[7] determined the same quantity in spruce wood by means of most concentrated hydrochloric acid. In the lignin separated in that manner Hägglund could not show an acetyl group that could be split off, consequently it was completely split off by this treatment. The lignin contents must therefore be increased from 28 to 30 per cent by addition of the acetic acid mentioned which is split off.

As to the wood the following composition (in round numbers) might therefore be assumed:

Carbohydrates	68%
Lignin	30%
Other substances.....	2%

and the lignin consists of about 63 per cent α- and 37 per cent β-lignin.

I have analyzed the cyclic β-naphthylamine salt from different experiments and fractions and obtained the following results:

	N	S
1.	1.94%	5.26%
2.	2.01%	5.25%
3.	2.12%	5.43%
4.	1.94%	5.42%
5.	2.07%	5.22%
Average	2.02%	5.31%
Atom ratio	1	1.14

Probably the Kjeldahl nitrogen method gives a somewhat too low result, so that the salt in reality contains 1 atom sulphur for 1 atom nitrogen.

Using the formula mentioned for the α-lignin, the formula for the cyclic salt becomes $C_{20}H_{22}O_7SN$:

		Calc.	Found
$C_{20}H_{22}O_7$	517	....	....
S	32	5.68	5.31
N	14	2.48	2.02
	563		

It is evident from what has been said above, that the sulphur contents, and therefore also the nitrogen contents, will be found a little too low.

Consequently the salt contains only one acrolein group for the given formula.

I[8] have tried at an earlier occasion to determine the hydroxyl contents in the α-lignin by the action of p-brombenzoyl chloride on the salt. For 1 atom S, 0.55 atom Br (or OH) was obtained. A considerable contamination with KCl made it

[3] M. 31, Vol. 1 (1918).
[4] Loc. cit.
[5] Loc. cit.
[6] Verein d. Zellstoff- und Papier-Chemiker, Hauptvers, 1908.
[7] Arkiv. f. Kemi, 1918, 11.
[8] Schriften d. Vereins d. Zellstoff- u. Papier-Chemiker, 1911, Vol. 2.

"A Green Chain Grate Stoker has been on the job continuously for the past seven years and during this time we have had no shut downs due in any way to the stoker. The only repair work that has been done has been the replacing of some of the links and clips." Mr. Hill, Chief Engineer, Great Lakes Wall Paper Company, Chicago, Illinois.

When Your Stoker Breaks Down- What Does It Cost You?

THE above excerpt from Mr. Hill's letter tells the experience of hundreds of users of Green Chain Grate Stokers. Breakdowns due to stoker maintenance on Green Chain Grates are almost unknown.

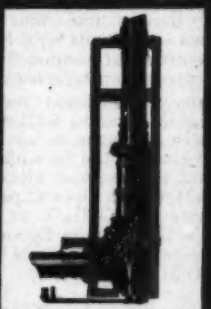
According to Mr. Hill, they have no auxiliary to fall back on, and a breakdown would mean shutting down the plant until repairs were made.

On Green Chain Grate Stokers links and clips are replaced while the stoker is in operation. The patented Green oval bar construction makes this possible.

Twenty-five years of experience in designing stokers and furnaces have taught Green Engineers the value of low maintenance and continuous performance. Green Chain Grate Stokers embody the correct principle and design to insure these.

Green Engineers will be glad to assist you in solving your particular maintenance problem. There is no obligation involved on your part. Write Dept. R.

Green Cast Iron Storage Hopper



Green Steam Jet Ash Conveyor

Green Engineering Company

170 Kennedy Ave.
East Chicago, Indiana

Green Chain Grates

Chain Grate Stokers, Ash Conveyors, Cast-Iron Hoppers, Sealflex Arches, Pressure Waterbacks.

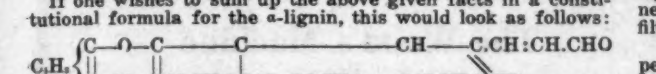
impossible to consider the experiment as decisive. It is much better to methylate in alkaline solution with dimethyl sulphate. The reaction proceeds easily even at ordinary temperature, and from the neutralized solution a salt may be obtained by precipitation with alcohol which, like the original, gives the cyclic salt.

This methylated salt gave 19.7 per cent CH_3O. The ratio of the methoxyl contents in the original and the methylated salt is now 2:3.06. In the total salt complex there does not exist, consequently, more than one hydroxyl, but 2 methoxyls.

But since this hydroxyl in the wood itself is acetylated, it follows that the α-lignin in the wood itself does not contain any free hydroxyl.

It is interesting that the methylated salt does not precipitate a glue solution which the original salt does. Hydroxyl or acetoxyl must consequently exist in the coniferyl aldehyde nucleus.

If one wishes to sum up the above given facts in a constitutional formula for the α-lignin, this would look as follows:



This formula is, of course, partly hypothetical, but it has all known quantitative and qualitative facts to its credit.

As we see, according to this conception the α-lignin is built after the flavonol type. The one nucleus must, however, on account of the composition of the lignin be considered as hydrated; this has probably lessened the intensity of the color of the sulphonic acid.

The position of the aromatic nucleus in relation to the chromon nucleus is founded on the fact that, according to experiments made by me, and repeated several times, it is impossible to couple the lignosulphonic acid to diazo compounds and in that manner produce azodyes.

Hönig and Spitzer[9] obtained by the fractional precipitation of the barium lignosulphonate a residual salt that could not be precipitated by alcohol. On account of the analysis the salt was given the formula $C_{21}H_{27}O_{21}SBa\frac{1}{2}$. It therefore contains considerably less sulphur than the other fractions. It is not improbable that it is a compound of the lignosulphonic acid and a carbohydrate.

That this explanation seemingly is right may be found from the following: If the lignosulphonic acid is completely precipitated from the waste liquor by means of β-naphthylamine hydrochloride in a solution acidified with hydrochloric acid, the precipitate removed and the solution subsequently heated on a waterbath for 12 hours, one obtains upon addition of naphthylamine hydrochloride again a yellow precipitate which is the same cyclic salt. In comparison with the first precipitate the quantity is, however, this time very small.

2. Carboxyl lignin (β-lignin), $C_{20}H_{22}O_9$.

It is mentioned above that the quantity of lignin in fir wood is 30 g. for 100 g. wood, out of which 19 g. is α-lignin, and therefore 11 g. β-lignin, so that the lignin consists of 63 per cent α-lignin and 37 per cent β-lignin. It is also mentioned that the spruce wood is composed of 68 per cent carbohydrates, 30 per cent lignin and 2 per cent other substances.

Without making an error that influences the calculation in a degree worth mentioning we might assume that the "other substances" contain 60 per cent C to 10 per cent H.

Since the formula for the α-lignin is $C_{22}H_{22}O_7$, the formula for the β-lignin is found to be $C_{20}H_{22}O_9$.

The total lignin has then the following calculated composition:

Carbon			63.45%
Hydrogen			5.20%
Oxygen			31.35%
			100.00%
Carbohydrates	68%, C =	$\frac{68 \times 44.45}{100}$	= 30.23%
Lignin	30%, C =	$\frac{30 \times 63.45}{100}$	= 19.04%
Other substances	2%, C =	$\frac{2 \times 60}{100}$	= 1.20%
		C	= 50.47%

[9]M. 31, Heft 1 (1918).

Carbohydrates	68%, H =	$\frac{68 \times 6.1}{100}$	= 4.15%
Lignin	30%, H =	$\frac{30 \times 5.2}{100}$	= 1.56%
Other substances	2%, H =	$\frac{2 \times 10}{100}$	= 0.20%
		H	= 5.91%

The above calculated figures give a good average composition of the spruce wood: C = 50.47 per cent, H = 5.91 per cent.

Whether the β-lignin is a chemical individual or not, its empirical formula must be $C_{20}H_{22}O_9$.

If the α-lignosulphonic acid is precipitated from the waste liquor with α-paphthylamine sulphate, it is possible to precipitate a dark colored salt with methyl alcohol after having neutralized the first filtrate with chalk and concentrated the filtrate. The salt was purified by solution and reprecipitation.

This salt gave, after deduction of the calcium sulphate (2 per cent) 6.26 per cent sulphur and 7.86 per cent calcium. Consequently sulphur and calcium atoms are present in the same number in the salt. From this may be concluded that the β-salt contains both a sulphonic acid and a carboxylic acid group. The simplest conclusion is that while the α-lignin contains an acrolein group, R.CH:CH.CHO, the β-lignin contains an acrylic acid group R.CH:CH.COOH.

The composition is also in harmony with the given formula $C_{20}H_{22}O_9$:

		Calc.	Found
$C_{20}H_{22}O_9$	438	....	....
S	32	6.27	6.26
Ca	40	7.84	7.86
	510		
CH_3O	31	6.07	6.44

The salt consequently does not contain more than one methoxyl. It is self-evident that the β-lignin in the wood does not possess a free carboxylic acid group. This lignin must therefore be combined to the carbohydrates in the wood. Since now, as I have shown before[10], the simpler carbohydrates, the pentosans, are in major portions, extracted from the wood, though difficulty, even by water, it is evident that at least the greater portion of this lignin is combined to the cellulose of the wood. Probably this is also the case in respect to the α-lignin. The lignin can hardly be conceived as having been formed by a secondary transformation of the cellulose. Both probably originate by an assimilation process directly from carbonic acid and water (formaldehyde). The existence of lignin seems, therefore, to be dependent on the existence of chlorophyl.

I believe that the general conception of the origin of the first assimilation product is according to the formula:

$$CO_2 + H_2O = CH_2O + O_2$$

The reaction process for β-lignin then becomes:

$$19\ CH_2O = C_{20}H_{22}O_9 + 10\ H_2O$$

and for α-lignin:

$$22\ CH_2O = C_{22}H_{22}O_7 + 11\ H_2O + 2\ O_2.$$

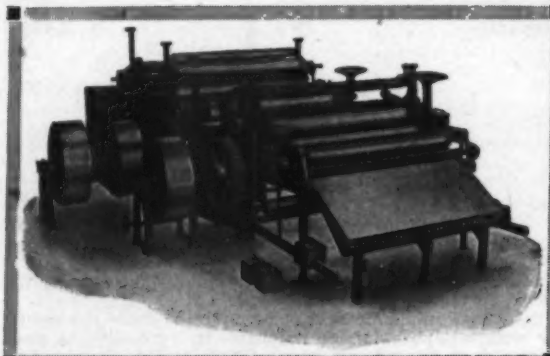
According to this conception a decomposition of the water likewise belongs to the primary assimilation process.

Starting on the basis that the wood contains 30 per cent lignin of the given composition (which exactly coincides with the composition of the wood itself) and considering that the α-lignin therein (19 g. per 100 g. wood), by treatment of the wood with sulphuric acid of 70 per cent H_2SO_4 or very concentrated hydrochloric acid, loses its acetyl complex, we find by simple calculation that the lignin after the loss of this acetyl group has the following composition:

	α-lignin	β-lignin		
Carbon	11.46	6.44	17.90 g	63.91%
Hydrogen	0.96	0.49	1.45 g	5.17%
Oxygen	4.59	4.07	8.66 g	30.92%
	17.01	11.00	28.01 g	100.00%

Consequently 28 g. lignin must be obtained by treating 100 g. wood in the mentioned manner. But both Hägglund and I have, as mentioned before, determined the yield of lignin to be about 28 per cent. The lignin prepared by means of sulphuric acid has been analyzed by me[11], that prepared by means of hydrochloric acid by Hägglund[12]. If it is assumed that

[10]Loc. cit.
[11]Loc. cit.
[12]Arkiv f. Kemi, 1918, 13.



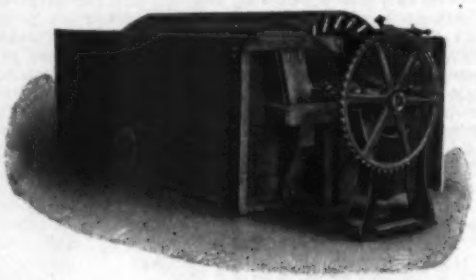
Rogers and Special Wet Machines

SINGLE AND DOUBLE PRESS
FOR CONVERTING CHEMICAL PULP INTO SHEETS 48% DRY

25-30 TONS air-dry pulp per 24 hours. Built in 72" width only, with patented pulp weakening and separating device or our new automatic knife cut-off attachment.

FREIGHT CHARGES are greatly reduced. Savings on this item alone often pay for the machine in one year.

110 Machines Now in Use. 28 Sold the Past Year



The Wood's Machine

Used as Pulp Thickeners, Savealls, Pulp Washers and Water Filters

ADVANTAGES:

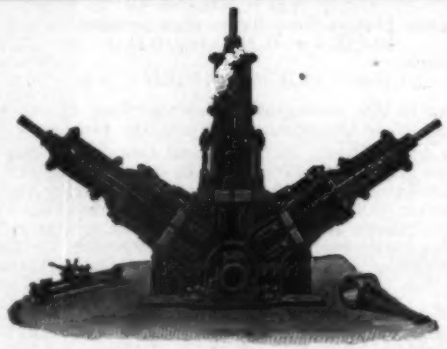
Reduced Wire Costs	No Couch Roll
Enormous Capacity	Minimum Repairs
Only 2 H. P. Required	No Doctor
Works Automatically	Requires No Attention

TWENTY-NINE SOLD DURING THE PAST YEAR

Wells Undulating Knot and Sliver Screen

Will bear closest investigation from every angle. It separates knots and slivers from all kinds of pulp efficiently, continuously, automatically with negligible cost for operation and upkeep. Simple but rigid construction. Only best materials used. Operation in plain view.

60 TONS DAILY CAPACITY, STANDARD SIZE. WRITE FOR BLUEPRINT AND FURTHER INFORMATION



Standard Wood Pulp Grinder

Built in Three Sizes

Taking wood 24", 30" or 32".
Bridge-trees—Are well proportioned.
Flanges—Made of steel, 40" diameter.
Hydraulic Cylinders—Copper lined, 12", 14" or 16" diameter.
Pillow Blocks—22" length of bearing.
Pockets—Very heavy and designed particularly for free discharge of pulp.
Service—Continuous distinctive service is always assured.

PULP AND PAPER MILL MACHINERY
GLENS FALLS MACHINE WORKS
GLENS FALLS, NEW YORK

besides acetic acid also 2 mol. water are split off from the lignin molecule, the result is the following:

	Calc.	Found Hägglund
C	66.41	66.40%
H	5.07	5.42%
O	28.52	.....
	100.00	

According to the calculation the wood should give 3.78 per cent CH_3O. Benedikt and Bamberger found 4.65, Klasson and Segerfelt as an average 3.77, Hägglund 4.98 per cent.[32] I have again determined the methoxyl contents of the spruce wood with the utmost care and using fresh hydriodic acid of the sp. gr. 1.74 and found 4.09 and 4.04 per cent. Disregarding the possibility that the methoxyl contents in the spruce wood may vary to some extent, I may here draw the attention to the fact, discovered by Tiemann, that coniferyl alcohol yields not only methyl iodide, but also some ethyl iodide, evidently originated from the complex $R.CH:CH.CH_2.OH$. Because a related complex is present in the lignin in the wood normally, a little more iodide than equivalent to its methoxyl contents must be produced. The methoxyl contents in coniferin I determined to 9.73 per cent, calculated 8.20 per cent. The concordance between the calculated and the determined methoxyl contents in the wood is therefore complete.

According to the calculation the lignin prepared with acid should show 14.5 per cent CH_3O. Hägglund found 14.39 per cent. One determination made by me gave 14.3 per cent.

The weight ratio between α-lignin and β-lignin and also the total lignin contents may be considered variable to some extent. The somewhat varying composition of the wood and also the varying statements of the heat value of the wood point in that direction. Because the β-lignin has a considerably lower heat value than the α-lignin, a slight variation between them must influence the heat value perceptibly. But on the other hand the ratio of the α-lignin to β-lignin is close to 2 mol. of the first for one of the latter. It might not be improbable that this is no mere chance happening, but that the greater part of the lignin is a compound of these two which is combined as a carboxylic acid directly with the cellulose. The conformity with the tannins would then be complete.

It may be concluded from the above said, that in the case of complete extraction of the lignin from 1 kg. spruce wood 79.1 g. SO_2 and 34.6 g. CaO must be combined to the lignin. The reports of the test cooks in the industry give for well cooked pulp about 76 g. SO_2 and 32 g. CaO, whereby, however, must be noticed that thealdehyde complex of the α-lignin in the waste liquor is not completely saturated with sulphite. The carboxyl group in the β-lignin and the acetic split off exist uncombined in the waste liquor.

Recommended Specifications for Limestone and Lime in the Manufacture of Sulphite Pulp

(Revised March 15, 1922)

1. General

(a) Manufacture of sulphite pulp.

(1) The manufacture of pulp for paper making from wood, by means of the sulphite process, consists of the following operations:

(1) Preparation of the wood,
(2) preparation of the cooking liquor,
(3) cooking of the wood,
(4) washing and screening the pulp,
(5) bleaching the pulp, and
(6) preparation of the finished pulp for shipment.

The use of limestone and lime in this manufacturing process occurs in the preparation of the cooking liquor. This liquor is produced by the reaction between sulphur dioxide and limestone or lime and the two absorption methods in common use are called the tower system and the tank system. The liquor is essentially a calcium or calcium and magnesium salt of sulphurous acid and its function is to affect the non-cellulose part of the wood in such a manner that, in the washing and bleaching process, nearly pure cellulose may be obtained.

(2) Discussion of use of high calcium and high magnesium stone and lime.

There is some difference of opinion in this country as to the relative merits of high calcium and high magnesium stone and lime for use in the two absorption systems. The difference in practice in the various pulp mills does not seem to be based on accurate data. As a result of a summary made during the war, the following conclusions may be drawn:

(b) Limestone.

(1) Definition: High calcium limestone consists essentially of calcium carbonate. High magnesium limestone consists essentially of calcium and magnesium carbonates when the proportion of the latter does not exceed 45.5 per cent.

(2) Use of limestone in the tower system.

The tower type of absorption system consists of one or more towers varying in height from 20 feet to 150 feet and charged with limestone resting on gratings. A stream of water, with or without the addition of reclaimed liquor trickles over this stone, while the sulphur dioxide enters at the bottom, rises and acts upon the moist stone and is absorbed by the downward flowing film of water.

(3) In the tower system, high calcium stone is desired, due principally to the fact that when high magnesium stone is used the calcium carbonate goes into solution first, causing the stone to crumble and leave a slude. For this reason, in a tower system using high magnesium stone, it is customary to have the grates raised 40 to 50 feet and they require frequent cleaning. One mill is using and recommends high magnesium stone. However, most of the mills are using high calcium stone and, in fact, several were using marble having a calcium carbonate content of 98.5 per cent. It cannot be said, however, that high magnesium stone cannot be used in the tower system, but it is not the most common practice.

(4) Packing.

Limestone is shipped in bulk in carload lots.

(c) Quicklime.

(1) Definition: Quicklime is the product resulting from the calcination of limestone. It will slake when water is added to it and this slaking is accompanied by an evolution of heat and an increase in volume.

(2) Use of lime in the tank system.

In the tank or milk of lime system, the base is in solution or suspension in a series of tanks, equipped with suitable agitators. The sulphur dioxide is forced or drawn through these tanks successively. The contents of the first tank are drawn off when the liquor has reached a certain strength (3.5 to 6 per cent total SO_2) and the contents of the second and third tanks progress to the first and second tanks respectively. The third tank is again charged with fresh milk of lime, and thus may be considered as a continuous process. In some cases, the tanks are built on top of each other in the form of a tower.

(3) In the tank system, a lime high in magnesium is desired, due to the fact that the magnesium salts are soluble, while the calcium salts are not so soluble and have a tendency to clog the system. But due to variations in tank systems, it is probable that a high calcium lime would give good results in certain instances.

(4) Packing.

Quicklime is shipped either in bulk in carload lots or barrels holding 180 pounds net or 280 pounds net each.

2. Requirements

(a) Quality.

The quality of the stone or lime should be reasonably uniform and in the case of the high magnesium stone or lime, the proportions of magnesium and calcium should be kept as nearly constant as possible.

(b) Limestone.

(1) Composition.

In view of the fact that various systems may use different grades of stone or lime, the requirements of these specifications are so given that they will meet the conditions of the pulp mills in this country. The maximum and minimum quantities are given in the following table:

	High Calcium Stone		High Magnesium Stone	
Ingredients	Max.	Min.	Max.	Min.
Calcium oxide	...	54.0	...	30.2
Magnesium oxide ...	1.5	...	...	18.8
Oxides of silicon iron and aluminum	1.5	...	1.5	...
Organic matter	0.5	...	0.5	...

(2) Impurities.

The impurities present in a limestone must be evenly distributed throughout the mass, and must not be concentrated in visible strata or nodules which would clog the grates. The stone shall contain no strata of an argillaceous or organic nature which might cause the pieces of limestone to split.

(3) Size.

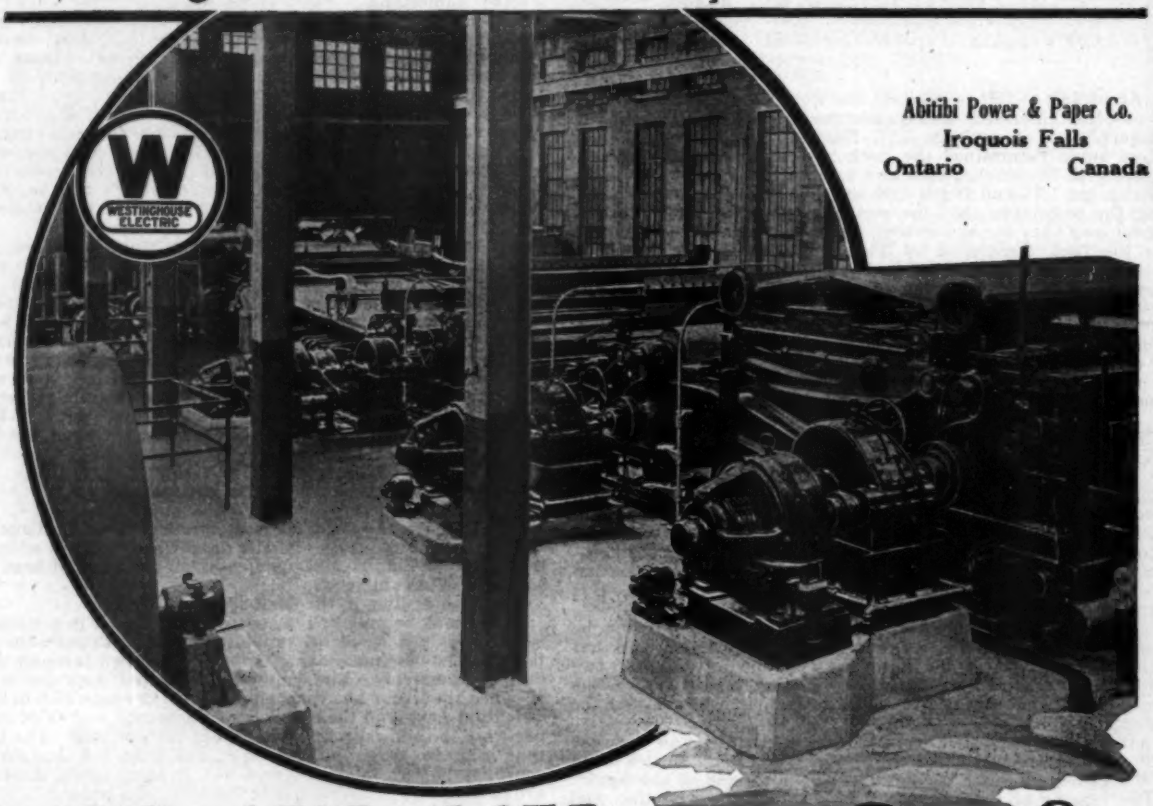
Each piece of limestone shall be large enough so that it will be retained on a three-inch ring, but small enough so that it can be lifted readily by one man.

(4) Density.

Limestone shall be of such a density that a block of it will

[32] In the instructions for Methoxyl determination, one occasionally finds that a little amorphous phosphorus is added to the hydriodic acid. This can, however, cause the formation of hydrogen phosphide, which precipitates silver phosphide in the silver solution, which leads to too high results.

Westinghouse Sectional Paper Machine Drive



Abitibi Power & Paper Co.
Iroquois Falls
Ontario Canada

What Would You Have Done?

Most people look with doubt upon new developments and await time to prove or disprove their value.

The Abitibi Power and Paper Co. purchased Westinghouse Sectional Paper Machine Drive when there was only one other sectional drive installation in the country employing an automatic system of speed control.

You might not have done as the Abitibi Company did, but the evidence of successful performance, *even then*, was convincing to this company, and its good judgment has been confirmed by the excellent operating results since obtained.

In every case where Westinghouse Sectional Paper Machine Drive has been installed, it has won unqualified approval.

Look over the list of advantages and write our nearest district office for any additional information desired.

Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.
Sales Offices in All Principal American Cities

The Reasons for Reduced Production Cost

INCREASED OUTPUT: — *Higher operating speeds. Production interruptions greatly reduced.*

LOW MAINTENANCE: — *Simplified drive; fewer parts.*

LESS SPACE:—*Less floor space than any other form of drive. Paper machine and drive on same floor.*

REDUCED HAZARD: — *Personal risk reduced by elimination of dangerous gears, belts, pulleys, etc. Fire hazard is minimized by the elimination of oil wastes and accumulations that accompany a mechanical drive.*

INCREASED RELIABILITY AND DURABILITY: — *Owing to the inherent reliability of standard electrical apparatus in universal use, this drive is unquestionably more reliable and more durable than mechanical drive.*

Westinghouse

weigh not more than 180 pounds, nor less than 150 pounds per cubic foot.

(c) Quicklime.

(1) Composition.

Ingredients	High Calcium Lime Max.	Min.	High Magnesium Lime Max.	Min.
Calcium oxide	...	93.0	...	56.0
Magnesium oxide ..	2.5	...	...	35.0
Oxides of silicon iron and aluminum	2.5	...	2.8	...
Organic matter	...	...	...	...

(d) Marking.

Each carload of material or fraction thereof, shall be legibly marked with the names of the consignor and consignee and with some means of identifying the particular contract on which the shipment is made.

(e) Retesting.

Notice of the rejection of a shipment based on these specifications must be in the hands of the consignor within 10 days after the receipt of the shipment at the point of destination. If the consignor desires a retest, he shall notify the consignee within 5 days of receipt of the notice of rejection. The consignee shall provide all reasonable facilities to permit the consignor to resample the material. This retest shall be at the expense of the consignor.

3. Sampling and Testing

(a) Sampling.

The purchaser will bear all expense of sampling and testing. When limestone or quicklime is shipped in bulk, the sample shall be so taken that it will represent an average of all parts of the shipment from top to bottom, and shall not contain a disproportionate share of the top and bottom layers. The sample shall consist of one shovelful for each three tons of material, but not less than 10 shovelfuls taken from different parts of the shipment. The total sample taken shall weigh at least 100 pounds, and shall be crushed to pass a 1-inch ring, mixed thoroughly and "quartered" to provide a 15-pound sample. This 15-pound sample shall be crushed to pass a ½-inch ring, mixed thoroughly, and quartered to provide a 2-pound sample for the laboratory. In case a shipment consists of more than one car, a separate sample shall be taken from each car.

When quicklime is shipped in barrels, at least 3 per cent of the number of barrels shall be sampled. They shall be taken from various parts of the shipment, dumped, mixed, and sampled as specified in the above paragraph.

When sampling quicklime, it is essential that the operation be conducted as expeditiously as possible, in order to avoid undue exposure of the material to the air. The sample to be sent to the laboratory shall immediately be placed in an air-tight container in which the unused portion shall be stored until the shipment has been finally accepted or rejected by the purchaser.

(b) Testing.

The following directions are a brief summary of the analytical methods which are recommended. For more complete information on this subject, references should be made to the Analysis of Silicate and Carbonate Rocks, by W. F. Hillebrand, United States Geological Survey, Bulletin No. 700.

Blast 0.5 g. of the sample for 15 minutes in a platinum crucible. Cool, and transfer to an evaporating dish. Mix to a slurry with distilled water. Add 5 to 10 cc. concentrated HCl. Heat gently until solution is complete, breaking up lumps if necessary. Evaporate to dryness on water bath. Add 5 to 10 cc. concentrated HCl, and dilute with an equal volume of distilled water. Digest on water bath for 10 minutes. Filter, and wash with hot water. Evaporate the filtrate to dryness. Dissolve in acid and water as before. Filter, and wash with hot water. Ignite the two precipitates together, and weigh as silica and insoluble matter.

Dilute the above filtrate to 250 cc. Add HCl if necessary to insure a total volume of 10 to 15 cc. of this acid in this solution. Make alkaline with NH_4OH. Boil until odor of NH_3 is barely noticeable. Filter, and wash slightly with hot water. Dissolve the precipitate with hot dilute HCl, and repeat the precipitation as before. Filter, and wash thoroughly with hot water. Ignite, and weigh as oxides of iron and aluminum.

To the filtrates from the above add a few drops of NH_4OH and bring to a boil. Add 25 cc. of a saturated solution of $(NH_4)_2C_2O_4$. Continue boiling until the precipitate becomes granular. Let stand until precipitate settles clear. Filter, and wash with boiling water. Ignite the precipitate, dissolve in dilute HCl, and dilute to 100 cc. Add excess of NH_4OH, and boil. Filter out any insoluble matter, ignite and weigh, and add its weight to the oxides of iron and alumina found previously. To this filtrate add $(NH_4)_2C_2O_4$, proceeding as before. Filter, and wash with boiling water. Ignite, and blast to constant weight as calcium oxide.

Acidify the filtrates from the above with HCl. Evaporate to 150 cc. Add 10 cc. of a saturated solution of $NaNH_4HPO_4$. Add NH_4OH drop by drop, with constant stirring, until the precipitate starts to form. Then add moderate excess of NH_4OH. Stir for several minutes. Let stand over night. Filter, and dissolve the precipitate in hot dilute HCl. Dilute to 10 cc., add 1 cc. of saturated solution of $NaNH_4HPO_4$, and precipitate as before. Filter, and wash with an alkaline solution made by diluting NH_4OH until it contains about 2½ per cent NH_3 and then adding a few drops of HNO_3. Ignite and weigh as $Mg_2P_2O_7$. Multiply this weight by 0.3621 to find the weight of MgO.

Concerning the Analysis of the Raw Sulphite Acid*

By Dr. Rudolf Sieber

IN a preceding paper[1] the differences in results that may be obtained in the titration of the raw sulphite acid according to different methods have been treated. There seemed to be reasons for investigating more closely the causes for these possible errors. I also considered it suitable to test some other suggested modifications in the analytical methods, especially as to their usefulness in the practice, in order to get a complete treatment of the question.

Much has been written about the divergencies in the results of the different methods; Oman[2] especially has drawn the attention to such possible errors. Oman attributes a great influence on the results of the alkali-metric method to the carbonic acid existing in the acid at the time of its preparation. Klason[3] has opposed this opinion, showing by calculation according to the Henry-Dalton law that the raw acid in the mill cannot contain more than 0.001 per cent carbonic acid. If Oman found higher values it must depend upon his method of preparation of the acid, which is divergent from the general practice.

Klason states that he has obtained concordant results with both the Winkler and the Höhn methods.

While the alkali-metric methods according to Oman give too low figures for lime, Thorbjörnsson states that the lime values obtained by himself, according to the Winkler method, are about 5 to 6 per cent too high. The cause for this divergency should, according to his opinion, be hydrolytic decomposition of the sodium sulphite formed in the titration.

This explanation is, however, not exactly true. It is easily calculated that the solution in which the titration is made is about 1/200 n. as to Na_2SO_3, if 1 cc. original acid with about 1.60 per cent free acid and 100 cc. distilled water is used. It is also easily shown that the increasing dissociation at strong dilution of the sulphurous acid itself is not accompanied by an increasing hydrolysis of the salt.

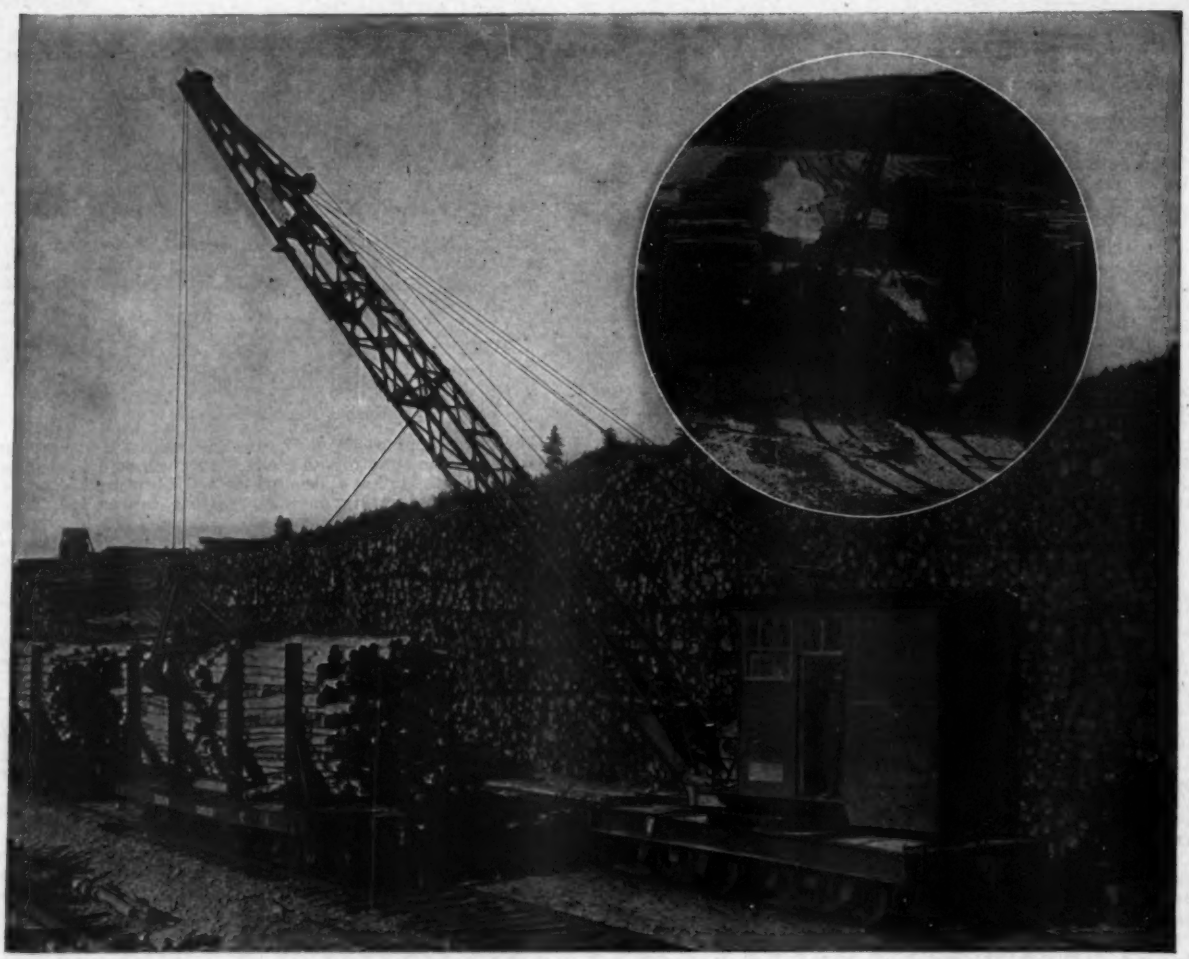
If a relatively weak dissociation of the free acid itself is assumed.[4] It may be calculated that the hydrolysis of the salt is about 0.00015 to 0.0003 per cent. If the concentration of the OH ions is calculated from this, the alkalinity, disregarding the (much lower) concentration of H ions, becomes about 0.0000007 to 0.0000016 mol. per liter.

This can no longer be measured with n/10 titration solutions; the concentration of the OH ions is therefore very slightly above the neutral point 10-6.9 mol. H. One may easily convince himself of this fact if one prepares a solution of sodium sulphite of equal concentration. For 100 cc. of the solution slightly colored with phenolphthalein traces of n/10 acid suffice for decolorization. In the solution which is titrated the hydrolysis is, in consequence of the presence of calcium sulphite, still less than that here shown. Any influence of such hydrolysis is impossible, which Klason[5] has also shown already.

For my part I can report that I in different mills almost without exceptions have obtained too high (5 to 15 per cent) values for the free acid with the alkali-metric methods. The observations have been made both on acids prepared from pyrites in tower systems and on acids prepared from sulphur

*A translation, with the special permission of the author, of "Om sulfitrasyrans analysering," which appeared originally in Svensk Pappers-Tidning. The translation, by Carl L. Fineman and W. E. Byron Baker, is solely for publication in Technical Association Papers.

[1]Compare Svensk Pappers Tidning, 1920, page 247.
[2]Teknisk Tidskrift, Kemi och Bergvetenskap, 1915, Nos. 4-5.
[3]Papierfabrikant, 1916, page 739.
[4]The values obtained in the literature are not valid for greater dilution than n/10; compare for instance, Landolt-Börnstein, Tabellen.
[5]Klason, Svensk Pappers-Tidning, 1919, Nos. 11 and 12.



FOR handling pulpwood in and out of storage, quickly and economically, use a Link-Belt locomotive crane equipped with a wood grapple.

The modern design and all around rugged construction of the Link-Belt crane fit it perfectly for the exacting demands of this work. Its serviceability makes it the owner's choice; its large and powerful clutches, and brakes, and convenient arrangement and accessibility of all working parts, make it the choice of the operator.

The Link-Belt crane can cut your handling costs in other work also—handling miscellaneous loads with grab bucket, hook-block, sling or magnet—switching cars, etc. In fact there is always useful and profitable work for a locomotive crane, at almost every industrial plant.

Send for our book No. 370

578

LINK-BELT COMPANY

PHILADELPHIA CHICAGO INDIANAPOLIS

New York . . Woolworth Bldg. Wilkes Barre . . 24 Nat'l Bank Bldg. Seattle . . . 920 First Ave., S. Louisville, Ky. . . F. Wehle, Starks Bldg.
Boston 9 . . . 49 Federal st. Huntington, W. Va. . Robson-Prichard Bldg. Portland, Ore. . . . First and Stark Sts. New Orleans . . C. O. Hine, 604 Carondelet Bldg.
Pittsburgh . . 1001 Park Bldg. Cleveland . . . 839 Kirby Bldg. San Francisco . . . 165 Second St. Birmingham, Ala. . . B. L. Morrow, 720 Brown-Marx Bldg.
St. Louis . . Central Nat'l Bank Bldg. Detroit . . . 4210 Woodward Ave. Los Angeles . . 168 N. Los Angeles St.
Buffalo . . . 547 Ellicott Square Kansas City, Mo. . 906 Rialto Bldg. Denver . Ellsworth, Shubert & Co., Boston Bldg.

In Canada - Canadian Link-Belt Co., Ltd., Toronto and Montreal H. W. CALDWELL & SON CO., CHICAGO, 17th and Western Ave. NEW YORK, Woolworth Bldg. DALLAS, TEXAS, 709 Main St.

LINK-BELT

according to the "batch system," formerly much used in Germany and America. The divergencies were, as a rule, smaller in the latter than in the former case. For this reason I believed in the beginning, in spite of Klason's opposing opinions, that carbonic acid sometimes may influence the analyses in a bad way. The equilibrium, according to the Henry law, which determines the carbonic acid contents in the acid, probably does not establish itself so rapidly that the acid always immediately after its preparation is free from harmful quantities of carbonic acid. Since the analysis of the acid is usually performed immediately after its preparation, it is possible to imagine errors caused hereby.

In spite of this I was fully convinced that the greater error, which sometimes was observed, could not be explained simply by this, and I believed it possible to conclude from some earlier observations that errors in the analysis were caused either by the titration liquids or by the distilled water not being completely free from carbonic acid.

In the analysis of the sulphite acid in the practice one works with only 1 cc., which is either used directly or in 10 cc. after tenfold dilution of the raw acid. Herein and also in the low SO_2 contents to be titrated in the acid we find the reason why even small divergencies in the consumption of titration liquid give considerable divergencies in the result. The absolute errors are very minute, but calculated as per cent they are very easily perceptible. Since these factors are not always observed, I may here give an example. The raw sulphite acid as a rule contains about 3 per cent total acid and a ratio of free to total acid of about 0.55 to 0.62. We may here assume 0.567. These figures correspond to 9.37 cc. n/10 iodine and 5.40 cc. n/10 NaOH (1.73 per cent free SO_2), if 1 cc. original acid is used. If now only 0.1 cc. n/10 NaOH too much is used in the determination of the free acid, the error is already 1.8 per cent, due to the presence of carbonic acid or something else. Since in the analysis the sample is diluted with much water, usually 1 cc. original acid and 100 to 150 cc. distilled water, it is evident without further reasoning what influence the carbonic acid contents of the water may have. According to my observations, 0.3 to 0.6 cc. n/10 $Ba(OH)_2$ is necessary as an average to neutralize the carbonic acid in 100 cc. distilled water. Treadwell[6] states 0.5 to 1.8 cc.; these high figures must, however, only have been noticed in water that had been standing for a long time. But it is evident that even the smallest figures give divergencies of 5 to 6 per cent from the real contents of free SO_2. It is also clear that very different results may be observed in different instances with the same method if this factor is not, which is the rule, duly considered. This is still more true, since the indication of phenolphthalein is uncertain in the presence of carbonic acid, and it is left entirely to the analyzing chemist to decide if the titration is finished at the first coloration or only when a standing coloration is obtained.

The alkaline titration liquids are also never completely free from carbonic acid and, therefore, strictly speaking, unsuitable for titration with phenolphthalein. Therefore, as a consequence of this, errors may occur. It is therefore justified to attribute a disturbing effect to the carbonic acid contents of the distilled water, of the alkaline titration solution, and finally of the sulphite acid itself. This fact was well known, but I hardly believe that one realized the degree of this influence, hence this explanation here.

I have tried to make the viewpoint clear by some experiments, and also tried to determine which precautions to take in order to obtain satisfactory results from the Winkler and the Höhn methods.

In order to avoid possible errors due to carbonic acid in the titration solution, some experiments were made, using n/10 $Ba(OH)_2$ instead of n/10 NaOH.

The results in Table 1 show that there did not follow any substantial improvement in that case.

It has also been tried to exclude the carbonic acid from the beginning from the distilled water by neutralization prior to its use with n/10 baryta water and phenolphthalein indicator. The results became much better, it being of no importance if one titrated as usual or poured the acid sample into an excess of alkali and then neutralized with the acid. Table 2 shows some of the analyses. The greatest divergencies are here about 6.4 per cent, compared to about 15 per cent in Table 1 (calculated on the CaO figures).

This good concordance could, however, not be maintained by this procedure in all tests. Even if the errors were smaller for all the samples than when using the usual method, divergencies often occurred which seemed to be caused by the presence of CO_2 in the acid. In order to eliminate the possible errors from this source the following procedure was followed:

The acid sample (diluted 1:10) was titrated in the known

[6]Treadwell, Quantitative Analysis, 5th edition, page 455.

TABLE 1

		CaO According to Höhn		CaO According to Winkler						
No.	Total SO_2 (Iodine) Per Cent	NaOH Per Cent	$Ba(OH)_2$ Per Cent	NaOH Per Cent	$Ba(OH)_2$ Per Cent	Sander Per Cent	Permg. Per Cent	Gravimetric Per Cent	CaO as $CaSO_3$, Per Cent CaCO	CaO as $CaSO_3$, Deducted Per Cent
1	2.764	0.962	0.940	0.901	0.922	1.044	1.091	1.102	0.061	1.041
2	2.772	0.982	0.969	0.942	0.938	1.082	1.123	1.129	0.087	1.042
3	2.805	0.981	0.970	0.994	0.982	1.106	1.110	1.144	0.070	1.074
4	2.613	0.936	0.982	0.896	0.908	1.021	1.080	1.155	0.088	1.067
5	2.790	1.012	1.023	0.996	1.003	1.103	1.146	1.172	0.052	1.120
					TABLE 2					
6	2.815	.....	1.102	.....	1.107	1.159	1.162	1.198	0.058	1.140
7	3.040	.....	1.122	.....	1.132	1.181	1.169	.....	.....	.....
8	2.882	.....	1.145	.....	1.110	1.190	1.240	1.258	0.070	1.180

manner with iodine in a porcelain dish. The resulting blue solution was then heated to the boiling point over a small flame and kept for about ten minutes at a temperature close to, but below the boiling point, carefully avoiding superheating of the walls of the dish. For this operation porcelain dishes must be used, because common titration beakers make it impossible to obtain accurate results. In spite of the moderate heating, they give off alkaline constituents. After cooling, the solution was titrated in the known manner with n/10 NaOH and phenolphthalein until rose coloration. A great number of such tests have been made; the results are up to all expectations. Table 3, which does not tabulate more than a part of the experiments made, shows maximum errors of about 2.2 per cent.

TABLE 3

		CaO According to Höhn						
No.	Total SO_2 (Iodine) Per Cent	Normal Per Cent	After Boiling Per Cent	Sander Per Cent	Permg. Per Cent	Gravimetric Per Cent	CaO as $CaSO_3$	CaO as Bisulphite
1	2.742	1.054	1.120	1.111	1.183	1.189	0.090	1.099
2	3.116	1.142	1.232	1.220	1.258	1.271	0.060	1.211
3	3.085	.....	1.254	1.237	1.291	1.298	0.073	1.225
4	3.328	1.193	1.268	1.285	1.314	1.331	0.065	1.266
5	2.830	1.043	1.125	1.125	1.168	1.196	0.081	1.115
6	2.710	0.931	1.016	1.041	1.082	1.105	0.093	1.012
7	2.925	.....	1.080	1.096	.....	1.152	0.068	1.084
8	2.875	1.078	1.122	1.160	1.192	1.224	0.062	1.162
9	3.020	.....	1.123	1.141	1.185	1.195	0.072	1.123

The color change of the indicator is very sharp in the boiled solutions. It does not change back as it did before.

In some few cases a divergency from the lime value, according to the Sander method, could be noticed, even if this procedure was followed. Whether these divergencies are caused by the presence of polythionic acids, or by something else, has not been determined yet. The number of these cases compared to the number of concordant analyses is, however, very small.

By this I may consider it proven that the above mentioned assumptions regarding the influence of the carbonic acid on the titration results, according to Höhn and Winkler, are right in the case in question. Simultaneously it has been shown that it is possible to obtain accurate results from the Höhn method if certain well determined precautions are taken in the test. The conditions may perhaps not give as great divergencies in other places, but everywhere the variation in the magnitude of the divergencies must be noticeable. This is the main uncertainty of the alkalimetric methods as they are generally used.

In respect to the accuracy of the alkalimetric methods, the results here obtained coincide completely with the results of Klason,[7] from which latter it may be concluded that the methods are founded on analytically clear facts.

As a consequence of what has been said above it was logical to try to make the Höhn method independent of carbonic acid present by the use of some other indicator. I have, therefore, tried two other indicators, methyl orange and paranitrophenol, because it gives a more distinct color change (colorless to yellow) than the first mentioned indicator, the change of which from red to yellow is less easy to see for most eyes than the reverse. The change of the paranitrophenol was distinctly visible; at the neutral point the solu-

[7]Svensk Pappers-Tidning, 1919, Nos. 11 and 12.

SOLVAY

STANDARD IN SODA SINCE 1881

SOLVAY ALKALI

SODA ASH 58%

Contains 99 + %
Sodium Carbonate

CAUSTIC SODA 76%

Contains 97 + %
Sodium Hydroxide

TRADE MARK

REG. U. S. PATENT OFFICE

Crown Filler

for

Paper Manufacture

Manufactured by

The Solvay Process Company

FACTORIES

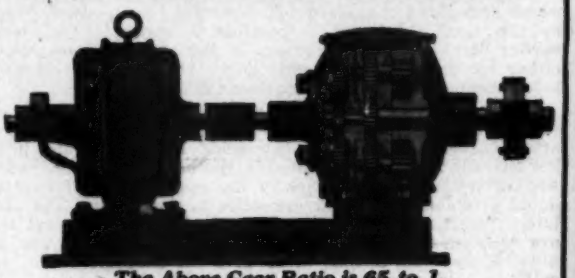
Syracuse, N. Y. Detroit, Mich. Hutchinson, Kans.

SELLING AGENTS

Wing & Evans, Inc.

22 William Street, NEW YORK
9 State St., BOSTON 625 Book Bldg., DETROIT
30 N. Dearborn St., CHICAGO

FOOTE SPUR GEAR SPEED REDUCERS AND WORM GEAR REDUCERS



The Above Gear Ratio is 65 to 1.

Eliminate Wasteful Methods

Foote Speed Transformers overcome the objections caused by open back gearing, chains and belts for speed reduction. They eliminate costly belt, gear and chain replacement, and prevent delayed production.

Foote Design Provides Highest Efficiency

Foote Speed Transformer design gives highest efficiency, compactness, durability and strength.
Foote Speed Transformers are entirely enclosed, oil tight, dust proof and fool proof.
They are simple in design, require practically no attention or maintenance.

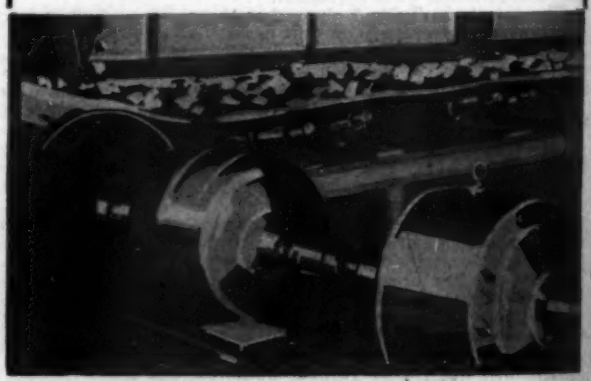
Consult Foote Engineers

Foote Bros. Gear & Machine Company

Manufacturers of Rawhide and Bakelite Pinions and Cut Gears of All Kinds—Send for Catalog.

Special Machinery Made to Order. Submit Your Blue Prints.

250-260 N. Curtis St., Chicago, U. S. A.



tion was colored faintly yellow upon addition of one drop alkali solution, and upon addition of one to two drops more, distinctly yellow. All titrations were made to that point. In the case of methyl orange the change was visible within three to four drops. Thanks to the fact that strong acids (H_2SO_4 and HI) were titrated it was possible to obtain good results with these indicators. Table 4 shows how the Höhn method was improved by the use of the two indicators.

TABLE 4

No.	Total SO_2 (Iodine) Per Cent.	CaO According to Höhn: Sander I Per Cent	Höhn: Normal Per Cent	Höhn: After Boiling Per Cent	Höhn: P.-Nitro-Phenol Per Cent	Höhn: Methyl Orange Per Cent	Perm. Per Cent	CaO as $CaSO_4$
1	3.058	1.137	1.013	1.170	1.160	1.140	1.129	0.03
2	3.153	1.175	1.070	1.181	1.172	1.175	1.210	0.06
3	2.480	1.022	0.942	1.038	1.009	1.016	1.072	0.04
4	3.008	1.148	1.072	.....	1.142	.....	.....	....
5	2.922	1.082	0.992	1.079	1.085	1.089	1.096	0.03

In connection with the above, I have tested some other suggestions regarding the titration of the raw sulphite acid as to their usefulness in the practice.

A long time ago Streeb[8] suggested to avoid the expensive iodine titration by the use of caustic soda and two indicators, methyl orange and phenolphthalein. First Streeb titrates the acid samples with methyl orange and obtains the first color change when all the SO_2 present exists as bisulphite (methyl orange reacts neutral towards bisulphite). Then he continues the titration and obtains the color reaction of the phenolphthalein when all the SO_2 exists as neutral sulphite. From these two figures it is easy to calculate the composition of the acid. It is consequently possible to save the expensive iodine solution.

It has also been suggested several times[9] that the titration for the free acid be made with normal alkali instead of the n/10 NaOH in order to obtain greater accuracy and independence of the carbonic acid in the distilled water.

A. Sander[10] has finally a short time ago worked out a method for this purpose. This method is also such that the expensive iodine solution is avoided and only n/10 NaOH employed. The method is founded on the fact that bisulphite compounds react with an excess of mercuric chloride under formation of complex mercury compounds (salts of the mercury-sulphonic acid) and hydrochloric acid. For each mol. H_2SO_3 one mol. HCl is formed.

$$Ca\begin{matrix}HSO_3\\HSO_3\end{matrix} + \begin{matrix}HgCl_2\\HgCl_2\end{matrix} = \begin{matrix}HCl\\HCl\end{matrix} + \begin{matrix}HgCl.SO_3\\HgCl.SO_3\end{matrix}\Big\rangle Ca$$

Sander makes the determination in the following manner: 5 cc. sulphite acid is titrated with n/10 NaOH and methyl orange; by this the free acid over bisulphite is transformed into bisulphite. Like in the first case (Streeb) one cc. titration solution equals 0.0064 g. SO_2. An excess of saturated mercuric chloride solution is now added to the solution, giving the above mentioned reaction as a result. The hydrochloric acid formed is then determined by continued titration with n/10 NaOH and the total SO_2 in the 5 cc. sample determined. From these figures it is easy to calculate lime and bisulphite.

Regarding the applicability of these latter methods, I can communicate the following as results of my investigations:

As to the titration with normal solution, the values do not become better for the free acid; they are still perceptibly higher than the true values. This was, of course, to be expected, since the influence of the carbonic acid cannot be avoided in this manner. One will not find any advantages over the use of a weaker alkali solution.

Almost the same is true of the Streeb method. The real advantage of the iodine saving is offset by other drawbacks. The greatest drawback is the uncertainty of the color change of the methyl orange indicator. The reason for this uncertainty is that the raw acid contains only relatively small amounts of really free SO_2, sometimes even acids are found that are nothing but bisulphite solutions; that is, show a ratio of 0.50. As a rule the really free SO_2 that is, SO_2 over bisulphite, seldom is more than 15 or at the highest 25 per cent of the total SO_2, corresponding to a ratio of 0.575 or 0.62 respectively. It is very easily calculated that if the total SO_2 is 3.00 per cent and the ratio 0.60, the consumption of n/10 NaOH does not reach 1 cc. (assuming that 1 cc. of the sulphite acid is used for the test). If we now consider that the methyl orange hardly gives a clear indication within 0.2 cc. in the titration of the medium strength acid, it is clearly seen that the results, even those obtained by a trained chemist, must be rather uncertain. This is still more true, since the other indication (phenolphthalein) in a colored solution is much less distinct than the change from a colorless solution.

It is not surprising that Goldberg suggested paranitrophenol instead of methyl orange. But, according to my experience, one does not gain very much in this case before one starts to use 5 cc. of the raw acid. In this manner the percentage error is decreased. But the uncertainty at the second indication is in no way diminished, with methyl orange. When paranitrophenol is used this second indication is easier to see.

Due to its complete insensitivity to carbonic acid, methyl orange is, of course, the theoretically right indicator. The color change is, however, not clearly visible to most eyes when weak acids are titrated with n/10 NaOH, and usually an excess is necessary to make it perceptible. This drawback is not at all as serious in the case of the other indicator (paranitrophenol) wherefore it is to be recommended. But in both cases the titration is much more difficult than when, for instance, sulphuric acid is titrated.

Regarding the Sander alkalimetric method, I wish to say the following: The carrying out of this test requires great attention, as the same conditions prevail in respect to the indicator as in the Streeb method. As a rule, one also obtains somewhat too high figures for the free acid according to this method. The second indication is, however, much more accurate and distinct. Good results may be obtained according to this method, but hardly by anybody who is not familiar with chemical work. Even for such persons the results are not so good if artificial light is used and do hardly show the accuracy of the iodometric methods with their distinct indication. According to my experience, better results are always obtained by untrained persons when using the iodometric methods. It is, therefore, probable that the Sander mercury method may be employed in the laboratories, but not in the mills. The results are sometimes improved also in this case by the use of paranitrophenol, depending upon the personal eyesight of the analytical chemist. The results tabulated in Table 5 partly show slightly lower figures for the total acid. This might possibly be explained by the presence of other sulphur compounds, reacting only with iodine. This procedure might, therefore, give the best results if some other indicator, more suitable for n/10 solutions and bisulphite, was available (methyl red). The Streeb method mostly gives somewhat too high figures on SO_2 and correspondingly too low on CaO. This is, however, chiefly to be attributed to the uncertainty of the indication and the deportment of phenolphthalein towards carbonic acid. In spite of this, I would recommend, for the mentioned reasons, the iodometric method for the determination of total acid in the mill. The free acid may be determined either according to Sander's first method or according to the Höhn method, using methyl orange as an indicator. For laboratory use and for more elaborate investigations the new Sander method is suitable; I would advise the use of n/5 titration solution and not too great dilution.

TABLE 5

No.	Sander I: Total SO_2 Per Cent	Sander I: CaO Per Cent	Winkler: n/1 NaOH CaO Per Cent	Streeb: Total SO_2 Per Cent	Streeb: CaO Per Cent	Sander II: Total SO_2 Per Cent	Sander II: CaO Per Cent	Perm. Per Cent CaO
1	3.002	1.112	1.043	3.100	1.078	3.032	1.092	1.144
2	2.573	0.952	0.928	2.628	0.930	2.602	1.005	1.026
3	3.010	1.142	.....	3.085	1.110	2.982	1.111	1.151
4	3.042	1.181	1.092	3.021	1.106	.....	.....	.....
5	3.302	1.332	.....	.....	.....	3.291	1.301	1.352
6	2.645	1.087	0.998	2.470	1.061	2.605	1.003	.....
7	3.721	1.354	1.211	3.809	1.219	3.640	1.300	1.372
8	2.486	1.015	0.972	2.580	1.000	2.456	1.015	1.058
9	3.100	1.256	1.179	3.280	1.212	3.158	1.274	1.342
10	3.328	1.283	1.210	3.350	1.210	3.305	1.232	1.365

It must, therefore, be possible to obtain not only dependable figures for the composition of the acid prepared, but also, what is not less important, a means to determine more accurately the working methods and the utilization of the raw materials in the acid-making department. This is finally the chief object of the control analyses. With the methods used hitherto it has been possible to reach this goal only approximately, because they have given figures, more or less divergent from the true ones, according to the conditions. The newer or modified methods give much more accurate re-

[8] Wochenblatt f. Papierfabrikation, 1894, page 2197.
[9] e. g. Lunge Berl., 6th edition, Vol. 1, page 373.
[10] Wochenblatt für Papierfabrikation, 1920, page 2051.

Horton Digester Assembled in Plant

HORTON TANKS

AND STEEL PLATE CONSTRUCTION

Serve Many Purposes in Paper and Pulp Mills

Horton elevated tanks, digesters, pulp tanks, acid tanks, chip tanks and smoke stacks are well known in many mills.

We will gladly send you full information without placing you under any obligation

CHICAGO BRIDGE & IRON WORKS

CHICAGO	NEW YORK	MONTREAL
2445 Transportation Building	3139 Hudson Terminal	1133 Bank of Toronto Bldg.

Horton Elevated Sprinkler Tank

De Laval Direct Current Generators for Paper Mill Drive

DIRECT CURRENT generators have advantages wherever a wide range of speed adjustment is desirable. For supplying direct current two methods are available, either turbine driven direct current generators may be used or the current may be obtained from an alternating current distribution system by means of transformers, rotary converters or motor generators. The production of direct current by turbine driven generators is the most economical of steam, as well as most simple and lowest in first cost and operating expense.

The photograph shows a De Laval 600 K. W. geared turbine direct current generating set supplying current for the operation of a paper machine. Each set of rolls is driven by an individual motor, the speed of which can be adjusted independently of the other motors, so that each set of rolls can be run at the correct speed to take up the "draw" of the paper. The speed of the turbine is held within close limits by an oil relay governor, but the voltage can be adjusted by varying the excitation. There is, of course, no cyclical speed variation, as with a reciprocating engine.

De Laval steam turbines are built with velocity stages for small and medium size units where the exhaust can be used in heating, drying or other processes. Where high efficiency is desired and for large sizes pressure stage turbines are used. They may be designed for back pressure, bleeder, mixed flow or low vacuum service.

By means of the De Laval speed reducing gears, De Laval turbines are adapted for driving all classes of machinery, for rope and belt drive, and for direct connection to shafting.

Our Engineering Department will gladly study your pump and power requirements with a view to suggesting the most economical and suitable equipment and arrangement.

DE LAVAL

Steam Turbine Company

TRENTON, NEW JERSEY

232

sults; the average errors are hardly more than 1 to 2 per cent. The errors in the CaO figures are a little greater, but not at all as deceptive as in the case of the alkali-metric methods used up to the present time.

Synopsis. The results of a comparative investigation regarding the usefulness in the practice of older and newer methods for the analysis of raw sulphite acid are given. Sander's methods can be used among the newer ones, and among the older ones a modification of the Höhn method may be used, and these might be recommended for use in the mill laboratory or in the mill itself.

Engineer Per Rosenlund has given me extensive assistance in the carrying out of this investigation.

Stamso—Cotton Linter Pulp

By STEWART E. SEAMAN, the Stamsocott Co., Hopewell, Va.

MR. PRESIDENT, and Gentlemen of the Technical Association of the Pulp and Paper Industry, I greatly appreciate the opportunity to present to you the subject of "Cotton Linter Pulp." You are probably all acquainted with this new product. Much of this information was presented during January, before the Holyoke section of this Association, but I have added to that paper.

I shall begin with the source of the raw material. As cotton grows in the field and is plucked, more than 50 per cent of the product by weight is cotton seed. The balance is long staple cotton, which is removed at the cotton gin and is baled, going to the cotton market. The seed which has been removed by the ginning process, goes to the cotton oil industry. There are nearly 1,000 cotton oil mills scattered throughout the South. The cotton linters, therefore, are produced at the cotton oil mills.

What Cotton Linters Are

In order that you may understand what cotton linters are, probably an explanation of how they are made is in order. The wholly white seeds, which are about the size of navy beans, are placed in storage at the oil mills, and are received during the cotton ginning season.

The first process in working up the seed is to clean it, which is accomplished in large, revolving drums, during which process sand, stems, bolls, etc., are removed. The cleaned seed then goes to the linter machines, which consist of a series of small, circular saws about 14" in diameter and spaced about ¾" apart. These saws revolve rapidly and the seed, after passing over a magnetic separator, passes the saws, and in doing so the lint is torn off the seed. By adjusting the saws, any quantity that is desired can be torn from the seed. After coming from the linter machines, it is baled, and it is this product which is shipped to our plant at Hopewell and used by us as raw material.

There is by weight 10 per cent adhering to the cotton seed, or about 200 pounds to the ton. The normal crush of cotton seed is about four and one-half million tons per year. As 10 per cent of this is cotton, we would have 450,000 tons of cotton, providing all was removed.

The normal demand for linters is 500,000 bales, or about 125,000 tons, which, subtracted from the above, would leave 325,000 tons. Forty pounds, or one-fifth, would probably be left on the hulls, which would reduce the above by 90,000 tons, making 235,000 tons available, which would go to the paper trade.

Based on 300 days, this would yield about 800 tons per day, in addition to supplying the normal linter demand. You can, therefore, see that there is a great amount of raw lint available for the paper industry after the market for linter pulp has become established and all of the oil mills are equipped to remove the available lint from the seed.

The product removed from the seed has been commercially known as "linters." Linter pulp is established under the classification of "Cotton Seed Hull Shaving Pulp," which is actually the correct term to use in connection with this product. I have used "linters" and continue to use the term, as it is the one best known to the trade, but I wish to explain this classification to you. A first cut lint from the cotton seed is truly a "linter." Anything removed after that is a cheaper product and is really a "shaving" from the seed. The second or third cut lint or the hull fiber is, therefore, a cotton seed hull shaving, and the pulp therefrom is "cotton seed hull shaving pulp."

Many Grades and Qualities

As you can appreciate, there are many grades and qualities of linters. As mentioned above, there is 10 per cent by weight of lint on the seed, or 200 lbs. to the ton. Many mills take off what is known as "spinnable" lint, which represents 20 lbs. of this 200 lbs., after which they remove another 40 or 50 lbs., as a second cut, which is known as "mattress" lint. Some mills take off 40 to 90 lbs. in one cut, and sell this product as a mattress lint.

The depth of the cut of linters determines the length and quality of the fiber. It is practicable for us to use as deep a cut as is economical for the oil mills to make, which total would probably not exceed 160 lbs. The remaining 40 lbs., which is still available, would probably better remain on the seed, as some of the other cotton oil products, viz., the meal-cake, would be affected if all of the fiber were removed from the seed. This 40 lbs., after the seed is crushed, would remain on the shell, which is then known as the "hull." The fiber adhering to the hulls can be removed by several methods.

The grinding method is the one usually adopted, wherein the hulls are ground and the small pieces of hull, or shell, are sifted away from the fiber, through screens. The resulting fiber is then known as "hull fiber," and, of course, is largely contaminated with hulls, and the fiber itself has been somewhat shortened by the grinding process. The presence of the hulls requires more drastic treatment for cooking and bleaching than do the linters.

Influences of the War

During the war, there was a great shortage of cotton, and the only added source known was that which adhered to the seed. The Government, therefore, insisted that for every ton of seed crushed at least 145 lbs. of lint must be removed. Therefore, the various oil mills were forced to equip themselves with machinery sufficient to strip up to this amount.

The East St. Louis Oil Company and the Proctor & Gamble Company went further, and made large installations for grinding the hulls to make hull fiber, thereby obtaining all the cotton available. All of this cotton was used to make "gun-cotton," and the various linter-using industries were forced to do without until the war ended.

At the conclusion of the war, therefore, there was considerable machinery for producing these short-fiber cotton products, and the demand had dropped to practically zero. There was, further, the equipment available as discarded war machinery for purifying and bleaching cotton for gun cotton.

The company I represent, the Stamsocott Company, was formed for the sole purpose of utilizing the short fiber cotton, and finding a permanent outlet for it. Arrangements were made with the du Pont Company to take over its plant at Hopewell.

The owners of the Stamsocott Company consist of a group of the largest cotton oil mills in the country, which crush approximately one-fourth of all the cotton seed produced in this country.

How the Raw Lint Is Treated

The raw lint arrives in cars at our plant in 500-lb. bales. It is carefully weighed, the bale-ties and burlap are removed, and it is then fed into special opening machines, which tear the cotton apart thoroughly. Some bales are tightly compressed, which largely magnifies this problem. After being opened, the lint is further beaten and fed through special machines, which we have designed for cleaning the fiber. It is then picked up by a fan and blown directly into our digesters. Caustic liquors are added, and when the digester has been charged, the top is put on and the cooking proceeded with under a high pressure, for the purpose of eliminating the ligno cellulose, fats, oils, waxes, etc.

After the cooking operation, the stock is blown into washing tubs to remove the cooking liquor, after which it is dropped to bleach tubs, where it is bleached with calcium hypochlorite and given its final color with dilute sulphuric acid. The stock is then further washed and pumped over riffle troughs to our dryers.

We do not have the usual dryers employed at pulp mills, but have one especially designed for our purpose. You will probably be interested in some of the details of this dryer, as it will explain the reason for the condition of the fibers when received by you. The pulp flows to a lattice apron, where the surplus water drains away, and the wet stock is fed to a squeeze roll. Here it is pressed to 50 per cent moisture and does not form in a sheet, but comes through in numerous small bunches. These wads are conveyed by another lattice conveyor to what is known as a "picker." This consists of a revolving drum about 30 inches in diameter, covered with numerous small spikes. The wads are here torn apart into small bunches and are thrown on a distributing apron, which carries the stock to a wire apron, which is in the dryer

Plamondon Transmission Machinery

Products

Heavy Gearing and Friction Clutches for paper-mills, rubber-mills, tubemills, cement-mills, rolling-mills, stone quarries, and rock products, mining and coal-handling machinery, elevators and malt houses, turbines and water wheels, sugar refineries, packing houses, electric light plants, powder-mills, glass factories; cut gears and machine molded gears of all kinds.

Shafting, pulleys, hangers, couplings, collars, pillow blocks, worm-wheels, fly-wheels, and rope sheaves.

Makers of grey iron, and semisteel castings by analysis.

Special machinery built to order on modern tools at usual shop rates.

A. Plamondon Manufacturing Company

Engineers, Founders, and Machinists

Established 1859—Incorporated 1877

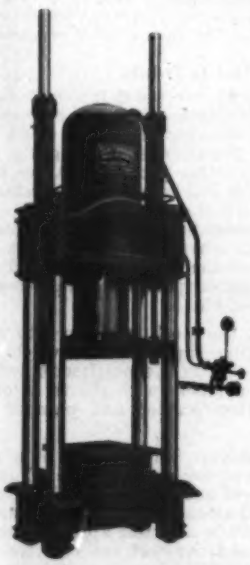
Works and Main Office:

5301 South Western Boulevard Chicago, Ill.

Emergency Orders Receive Special Attention

SOUTHWARK PULP PRESSES

For Long, Hard Service and Economical Operation



600-Ton Pulp Press

THE PRESS illustrated is typical of our improved designs, of all steel construction with the exception of the rams, which are chilled iron ground on the working surface and outside packed.

This press has pressing table 33″ wide by 46″ long, with ram stroke of 48″. It is designed for any standard working pressure up to 3500 lbs. Special sizes can be furnished to suit any requirements. These presses are equipped with Southwark two pressure three-way valves of forged body spindle type for controlling. Either the two pressure or single pressure system may be had.

The press is provided with bottom pressing table and improved drop track which does not require manual control.

We also build sulphite presses, baling presses, pumps and accumulators for the pulp trade and carry in stock a complete line of hydraulic valves, fittings and pipe.

It will pay you to have our quotations on your requirements.

SOUTHWARK FOUNDRY & MACHINE CO.

PHILADELPHIA PENNSYLVANIA

Branch Offices: Fisher Bldg., Chicago; Swetland Bldg., Cleveland

proper. This apron is about eight feet wide and on eighty-foot centers, and is completely housed in a steel chamber, on one side of which there is a row of steam coils. A fan causes air to circulate through these coils over the top of the wet cotton, down through the wire screen conveyor and back to the coils again. In this method the cotton is dried, as it passes slowly through the dryer and does not come in contact with any hot steam surface, being dried solely by the circulation of hot air.

The stock falls continually from the end of the dryer into a galvanized iron funnel-shaped hopper, from which it is picked up by a fan and blown through further cleaning machines, after which it goes to the storage bins. These are lined with galvanized iron and every precaution is taken throughout our plant to prevent contamination with dirt. The stock is forked from these bins to our bale press.

Here again, we had to design special equipment to handle our stock, and we now use a press that makes a bale without the necessity of bale blocks, the former use of which caused considerable trouble, due to the bale blocks breaking and contaminating our pulp with wood. A density of from 30 to 40 lbs. per cubic foot can be maintained in this press. When the proper length of bale has been obtained a pointed bar cuts off the bale, which is then bound with three strands of galvanized iron wire, after which the package is wrapped with a heavy kraft wrapper.

Test for Color, Moisture and Dirt

As the stock goes to the bale press, samples are taken from every bale and tested for color, moisture and dirt count. There is one man on each shift at our plant whose sole duty is to make these tests. He, in turn, is checked by our laboratory. Each bale made is given a number tag with a duplicate stub on it. The weights of the bale are marked by the scale man. The man making the tests then grades each bale, and a record is kept at our plant of every bale made. We can, therefore, check back at any time on any shipment, providing our customers will notify us of the tag number of any bale made. The stock is then loaded in cars, which have been carefully swept out and lined with a car liner. Careful attention is paid to placing the seams on the bales in such a manner that car dirt cannot sift into the packages.

You will gather from the above that we have taken great pains throughout our process to remove any dirt from the raw lint to keep our stock clean, and that, further, we keep a record of every bale made.

Several Qualities of Pulp

We have several qualities of pulp which we make for special purposes. Our regular product is tagged under the grade "Stamso AA." Some mills desire a semi-beaten stock, which is made the same as our AA grade, but is passed through jordans. The jordan treatment does not shorten the stock, but brushes it out, straightens and individualizes the fibers and hardens the stock quite a little. This semi-beaten product is sold under the grade "Stamso J." For special purposes, we pass our "AA" grade through dusting machines, which remove considerable short fiber, leaving a somewhat longer-fibered product to pass out the end of the screen. This we term "Stamso L." The short fiber product, which passes through the screens, is graded "Stamso S." Several mills, and particularly production mills, have experienced trouble in screening our "AA" grade, but all have had success with "J" grade.

Both "AA" and "J" grades have been used in grades of paper where a rag content is desired. Apparently the same quality of paper can be obtained from either grade. The "L" product has been made especially for celluloid, and we have a few customers who use this in paper, for they deem it somewhat cleaner than the "A" grade, which you can appreciate, as the dusting treatment eliminates some fine dirt, together with the short fiber. The short fiber product should be particularly adapted to book paper and papeteries.

It is somewhat difficult for me to attempt to discuss the manufacture of "Stamso" pulp into paper with you, gentlemen, who are all experts in paper making, but you will probably be interested in having me relate some of the findings in the use of our stock.

There is on exhibition here a complete line of papers under our watermark which were made by the Collins Manufacturing Company, of Holyoke, who are the first company that was willing to make a special campaign for business on linten paper and to admit the amount of our pulp in the paper they made. As you are all aware, the Collins Manufacturing Company only makes the highest grades of paper and all of which are loft-dried.

Stock Widely Used by Paper Companies

Practically every high-grade company in the country is now using our stock in some percentage, but it has not yet been their policy to reveal the amount contained. You will further note that these sheets are all very high grade, and that the objections raised against the use of lint by numerous companies have been overcome in the making of this paper.

I cannot tell you how the particular sheets on exhibition were made, but I shall try to explain how the different mills handle our stock. It is thrown either directly into the beater with the balance of the furnish, or first into a separate washer. When thrown into the beater, "Stamso" pulp is inserted first, as the stock requires lots of hard beating. When handled in this manner we would expect the greatest economy, as rehandling would be eliminated. Some mills have found it to their advantage to treat in a washer first.

There is one mill, who make all high-grade papers, who throw our stock directly into the beater, beating four to five hours, and do not give any preliminary washing steps except in their "weddings." They claim they do not have any trouble with this time of beating in obtaining the necessary pop tests and other properties of the sheet. The reason for placing the stock in the washer is that they have a fine, bright water, which further brightens our stock, and then by the use of a small amount of additional bleach, the color is improved.

Other mills handling our stock in about the same manner, average about six to seven hours' beating time. Some mills prefer to place our stock in a washer, where they keep it for about three hours with about 1,000 lbs. in a 1,200-lb. washer. The roll is set down almost immediately to the desired brush, and just before dropping, a small amount of bleach is sometimes added. The color, however, cannot be improved by this treatment unless a brighter water can be had at the paper mill than we use at our plant. (We stop manufacturing after our water exceeds five on the usual water scale.) The stock is then dropped to the drainer and handled the same as the regular half-stock.

Saving Cost

The object of our "J" grade was to eliminate the necessity of this washing step and to save you the added cost, at the same time to help those mills who thought linters too free and where they had encountered screening difficulties. We know one mill that makes a book paper, giving our "J" grade but two and one-half hours' beating, and uses 25 per cent in its furnish for the regular content. They do not experience any screening or other difficulties.

Some mills declare they would prefer to beat their own stock, and where they have ample washing and beater capacity, can probably obtain the best results by so doing.

You must all bear in mind that linters represent a new, unused, unworked, cotton fiber, which requires practically a new rag-beating time. Many paper makers have looked at our raw material and because they have seen considerable short fiber, they thought that linters were soft and would not require much beating, which is not correct. There is considerable long fiber in our pulp, and I believe that most of the difficulties encountered in handling lint has been due to not realizing the last mentioned points.

Many Difficulties Overcome

As you are all aware, in developing a new product like this, many difficulties are encountered that must be overcome. As they have been encountered, steps have been taken to eliminate them, and I feel quite sure linters represent the most uniform and the cleanest source of raw material for paper making that can be had. You all know the difficulties you experience in handling rags. Your magnetic separators will not pick out zinc buttons, rubber will escape the most careful inspection, burnt fiber is not eliminated and will show up in black specks, and particularly during the past several years permanent dyes have been encountered that cannot be successfully or uniformly bleached.

Linters will give a rag content with direct proportion to the amount used. Where thrown directly into the beater, the only loss in lint is in the tare of the package, which does not exceed 1½ per cent.

For permanent records, linters are most desirable, for they represent the maximum of true cellulose. "Stamso" pulp is from 98½ to 99 per cent alpha cellulose. New rags approach this figure, but contain certain foreign materials, like starch, clay and other fillers. Old rags contain a maximum of 85 per cent alpha cellulose. The best sulphite pulp does not run higher than 89 per cent alpha cellulose. It is because of this predominating alpha cellulose content that linters will make the best record paper.

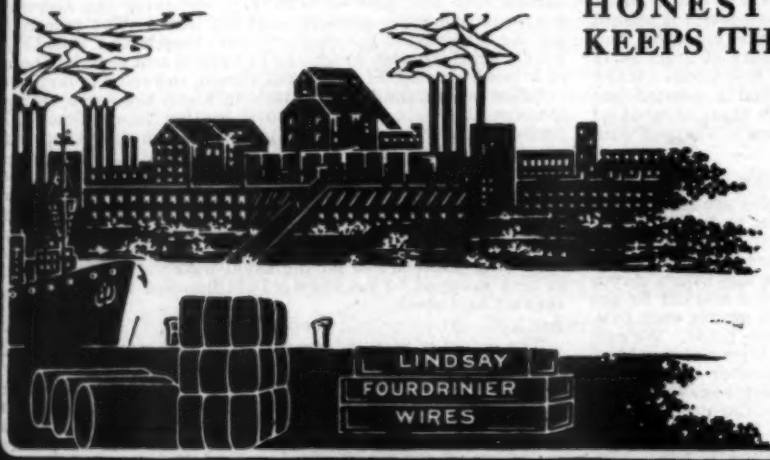
It has been found that linters will fold with the best quality of new rag. The pop test, however, falls somewhat short of the higher grade new rags, but the equivalent of the fancy shirts can be obtained.

As lint is a new cotton fiber that has not been worked or processed, it is not quite as compact and therefore gives somewhat more bulk to paper for the same unit of weight. Those

Real Merit Placed

Lindsay Fourdrinier Wires

In Many Mills



HONEST SERVICE KEEPS THEM THERE

They are ready to serve you

The Lindsay Wire Weaving Company

Collinwood Sta., Cleveland, Ohio

"Ask any Papermaker"

FOURDRINIER WIRES

Dandy Rolls *Cylinder Molds*

Brass, Copper and Iron Cloth

Bank and Office Railings

WIRE SIGNS

Cheney Bigelow Wire Works

Established 1842 SPRINGFIELD, MASS.

companies that have been using "Stamso" pulp can all testify to the added bulk obtained.

Cheaper Than Old Rags

You can use "Stamso" pulp to advantage in place of old rags at a saving over today's price of rags. The color is also much brighter than can be obtained from old rags. You can also use it in place of new rags in various proportions. I believe that 25 per cent can be substituted for new rags without your noticing any difference in high test papers, and that you can save from five to ten cents per pound over the cost of new rag half-stock, which should prove quite an item today. In "weddings" and papers of that description, you can use 100 per cent "Stamso" pulp in place of new rags at a very material saving. You will further get a greater bulk than you could from new rags. I do not claim you can get a pop test with "Stamso" pulp equal to a high-grade new rag, but I do claim you can get all the rest of the properties, including folding tests, and by substituting some "Stamso" pulp for new rag, you will free your stock appreciably and increase your production.

Future Demand

The advent of this stock should supply the need of additional cotton for paper making. You are aware that during the Civil War even news print was made entirely of rag, but as the demand for paper increased, it far surpassed the supply of rags. Linter pulp therefore, should not displace other paper making materials, but add to them and furnish a uniform source of supply in large quantity, and in many mills eliminate the objectionable dirt and filth of the rag room.

Concerning Lignin and Lignin Reactions*

By Dr. Peter Klason

IN my first experiments in the chemistry of wood pulp manufacture[1] I showed that the sulphurous acid in the sulphite digestion is combined in two ways, i. e., firmly and loosely, and as a working hypothesis I assumed that in the first case the sulphurous acid combined to an ethylene complex, analogous to, taking as an example, allyl alcohol + bisulphite:

$CH_2{:}CH.CH_2.OH + H.SO_3.OH = CH_2CH(SO_3.OH).CH_2.OH$,

in the latter case analogous to the known reaction of aldehydes and ketones to bisulphite. This process is reversible so that the free bisulphite in the solution is in equilibrium with the combined sulphite. Should the first be neutralized, an equal amount would be set free from the combined sulphite to establish a new equilibrium. This reversibility may be shown in the sulphite waste liquor in the following manner:

2 cc. waste liquor are diluted with distilled water to 100 cc., whereupon it is neutralized with lime water, using phenolphthalein as an indicator. In this certain case 8.2 cc. lime water = 3.67 cc. n/10 sufficed. If this neutralized solution was left standing for 30 minutes 0.4 cc. lime water = 0.18 cc. n/10 were consumed, and after 12 hours more 0.7 cc. lime water = 0.31 cc. n/10. After the first neutralization 0.6 cc. n/10 acid had consequently been formed gradually. The progress of this reaction can also be determined by the use of an iodine solution. In this case 5 cc. waste liquor consumed 4.2 cc. n/10 iodine. After one hour 0.45 cc. more, after a second hour 0.25 cc. and after subsequent 18 hours 0.6 cc. = a total of 1.30 cc. n/10 were consumed, equivalent to 0.52 cc. for 2 cc. of liquor. The latter experiment does not differ appreciably from the first one.

Later[2] I made the assumption that the lignin of coniferous woods had a constitutive similarity to coniferyl alcohol. This is, according to the well known investigations of Tiemann, built up in the following manner:

$$C_6H\begin{cases}CH{:}CH.CH_2.OH\ (1)\\OCH_3\ (3)\\OH\ (4)\end{cases}$$

The compound is consequently a substituted allyl alcohol, $R.C.H{:}CH.CH_2.OH$. One might assume that a part of the allyl alcohol complex might exist in an isomeric aldehyde form or as coniferyl aldehyde, $R.CH{:}CH.CHO$. This assumption is in line with all known facts. Since no other theory of the constitutional structure of lignin and the sulphite process has been able to carry weight with the pulp industry (to whom it is of paramount importance) and since no other, so far as I know, exists, the theory has been generally accepted. However, a theory, no matter how well founded, has not the value of a proven fact. It is evident that the foundation of such a great and worldwide industry as the manufacture of sulphite cellulose must be built upon the most possible complete knowledge of the chemical structure of lignin, or at least, of those complexes which are active in the digestion process.

Among botanical physiologists lignin is characterized by the so-called lignin reactions, above all Wiesner's phoroglucinol and hydrochloric acid reagent, which gives a red coloration. The aromatic amines are also good reagents, which, as a rule, produce a yellow color. Now we also know that vanillin and phloroglucinol produce a red color, and that with aromatic bases a yellow stain results. The assumption that the lignin reactions were due to the presence of vanillin, as first pointed out by Singer,[3] has been accepted almost generally. It also attained a certain degree of probability when V. Grafe[4] could produce vanillin even in crystalized form by the fusion of dried waste liquor with lime. I[5] was able to verify this statement through the preparation of protocatechuic acid directly from lignin by potash fusion.

H. Wichelhaus and M. Lange[6] subjected wood to superheated steam at 180° C. and found substances in the solution, which, upon being extracted with ether, produced lignin reactions, yet did not consist of vanillin.

Several years ago I made the following important observation in the chemistry of lignin. Salts of aromatic amines produce precipitates in the sulphite waste liquor under certain conditions. It is possible, especially when the liquor has been exposed to the air for some time, to precipitate almost completely lignosulphonic acid with, for instance, naphthylamine salts, leaving only carbohydrates in the solution. This observation made possible the investigation of the sugars in the liquor.[7]

Here I will give a short report of the reactions between lignosulphonic acid and the aromatic amine salts. β-naphthylamine proved to be the most practical base for this investigation.

Upon removal of the reversible combined sulphite the β-naphthylamine salt produces a bright yellow precipitate in acid solution. This really is a highly remarkable phenomenon. It is hard to believe that an ordinary ammonium sulphonate should show such a degree of insolubility. When dried the salt cannot be fused, but in the solution it melts at about 70° C. to a viscous mass; when the salt has been dried it is furthermore almost insoluble therein. The aniline salt shows some signs of crystallization ability, about which future experiments will decide.

However, one may next assume that the salt is a normal naphthylamine salt of lignosulphonic acid. The following experiment shows, though, that it fundamentally is something else; if the salt is treated with alkali and gentle heating it goes into solution and *naphthylamine precipitates*, just what must happen if a normal ammonium salt were there. If now the naphthylamine is removed by extraction with ether, one gets a clear, red-brown solution. If this is now strongly acidified with hydrochloric acid, a yellow precipitate results, having the same properties and the same composition as the original precipitate. The naphthylamine is namely only partially driven out of the salt by the alkali treatment. If the precipitate is filtered away and naphthylamine hydrochloride added to the filtrate, the same yellow compound is likewise obtained.

These facts can hardly be explained in any other way than that the complex $R.CH{:}CH.CHO$ is present in the lignin. The reactions are then the following:

1. $R.CH{:}CH.CHO + H.SO_3.OH =$
2. $R.CH_2CH(SO_3OH).CHO + C_{10}H_7NH_2 =$
   $R.CH_2.CH(SO_3.O.NH_2.C_{10}H_7).CHO =$
3. $R.CH_2.CH\begin{cases}SO_2.O\\CH{:}NH.C_{10}H_7\end{cases} + H_2O$

We therefore obtain an inner ammonium salt with naphthylamine coupled to the aldehyde complex, so that the whole forms a cyclic compound. This explains as well the insolubility in water as in dilute acid, and the color. If this salt is treated with alkalies the ring is broken in two forms, in part the alkali salt of the acid $R.CH_2.CH(CH{:}N.C_{10}H_7).SO_3.OH$ is formed, in part also the alkali salt of the lignosulphonic acid itself and free naphthylamine. It is now evident that upon addition of acid to the former salt the cyclic ammonium salt mentioned must be regenerated since the coupling occurs in acid solution and also that the same cyclic salt must be formed upon addition of a naphthylamine salt to

*A translation with the special permission of the author of a "Sonderabdruck" from the Berichte der Deutschen Chemischen Gesellschaft, which he sent to the translators, Carl L. Fineman and W. E. Byron Baker. The translation is exclusively for publication in Technical Association Papers.

[1] Tekn. Tidskrift, afd. Kemi 1893, 11.
[2] Sv. Kem. Tidskrift 1897, 135.
[3] M. 3, 409.
[4] Sitzungsber. d. Wien. Akad. d. Wiss., Abt. 1, 113, 253 (1904).
[5] Sv. Kem. Tidskrift 1917, 15.
[6] Ber. 49, 2001 (1916; 52, 2054 (1919).
[7] Sy. Pappers Tidning 1917, 176.

The Sandy Hill Iron & Brass Works

Hudson Falls
New York

Manufacturers of **Paper and Pulp Mill Machinery**

The Noble & Wood Machine Co.

Hoosick Falls, New York

LOOKING for an efficient process for treating your old paper stock?

Write for our Paper Pulping Engine Bulletin

Paper Mill Machinery

the liberated ignosulphonic acid. It may, however, be mentioned that one does not obtain this good result with all bases. The reaction may also proceed in such a manner that the coupling product is completely broken up.

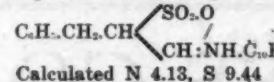
The reactions are so clear that no other interpretation seems possible. The lignin consequently must contain the acrolein complex, R.CH:CH.CHO, as a constitutional and fundamental part.

The precipitate does not possess exactly constant composition. The nitrogen contents is about 2 per cent, the sulphur contents 5.5 per cent. It therefore contains about 1.2 atoms S for one atom N. Probably the nitrogen determination according to Kjeldahl gives slightly too low results for the N contents.

Using fresh waste liquor one obtains per liter liquor with about 10 per cent dry substance about 41 grams of the yellow precipitate; if the liquor has been exposed to the air for years, one obtains about 50 grains. This cannot be easily explained in any other way than that the lignin contains not only the complex R.CH:CH.CHO but also the corresponding alcohol R.CH:CH.CH_2.OH, which is gradually oxidized by the oxygen in the air to the corresponding aldehyde. It is also possible that the ratio between the compounds varies in the wood itself.

The simplest aromatic forms of the mentioned complexes exist in cinnamic alcohol and cinnamic aldehyde. Compounds belonging to the cinnamic series are very common in the vegetable world.

Cinnamic aldehyde is the chief constituent of cinnamon oil and cassia oil. As a necessary complement of the investigation it was necessary to determine the deportment of the cinnamic aldehyde towards phloroglucinol and aromatic amines. It was found that cinnamic aldehyde gives a splendid red color with phloroglucinol and hydrochloric acid or Weisner's reagent, reminding one of the corresponding lignin reaction, but of a shade more like vermilion. From the literature we know that the cinnamic aldehyde is easily combined with aniline or naphthylamine to form yellow compounds, for instance, $C_6H_5.CH:CH.CH:N.C_6H_5$, and this I could also verify. If cinnamic aldehyde is heated in sealed tubes at 100° C. with sulphite cooking acid it is slowly dissolved. If the sulphite is then removed, β-naphthylamine hydrochloride precipitates a yellow substance. Proportionately to the coupling a plastic mass is precipitated, which becomes hard in the cold. The compound forms the cyclic salt:



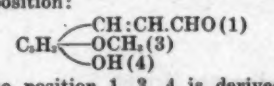
Calculated N 4.13, S 9.44
Found N 3.90, S 9.72.

The salt is soluble in methyl alcohol and difficultly soluble in water. The solution is fluorescent. It contains, like the corresponding lignosulphonate, somewhat more than one atom sulphur (1.08 atoms) for one atom nitrogen and is so similar to the lignosulphonate that they can easily be confused. For instance, it turns doughy in methyl alcohol before it dissolves. It is also decomposed by alkalies in the same manner. I hope to be able to report more extensively on these compounds at a later occasion.

Cinnamic aldehyde also coincides with the lignin in the wood in that respect that it is resinified by mineral acids. Consequently it is not only a hypothesis that the cinnamic aldehyde group exists in the lignin as a fundamental constituent, but it must be considered as a fact.

The great physiologic importance of the facts here shown is evident if we remember that all the phanerogams and vascular cryptogams give lignin reactions and that the lignin is almost one-third of the whole mass of the wood. They also have considerable technical importance. The chemistry of the sulphite cooking process depends on this aldehyde group.

In conformity with the formula given on page 1 for coniferyl alcohol the coniferyl aldehyde must have the following composition:



The position 1, 3, 4 is derived from the fact mentioned above that vanillin is obtained by heating sulphite waste liquor with lime.

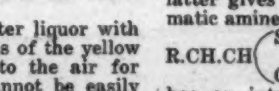
It can also be added hereto that, as I have already mentioned at another occasion,[8] methyl, ethyl and n-propyl creosol are obtained by the dry distillation of coniferous wood, all having the position 1, 3, 4.

We find likewise in the n-propyl creosol the three carbon atoms of the coniferyl alcohol and the coniferyl aldehyde.

It is consequently not vanillin in the wood that causes the lignin reaction, but coniferyl aldehyde. This also explains how Wichelhaus could obtain decomposition products of the wood that gave lignin reactions.

We consequently find that coniferyl aldehyde (and coniferyl alcohol) are fundamental and at the same time only outwardly chemically active components of the coniferous lignin, which all is in good harmony with the hypothesis made by me. The investigation is continued.

In the first part of this paper[9] I have shown that the spruce wood lignin contains an acrolein group, R.CH:CH.CHO, which is present in the sulphite waste liquor combined to sulphurous acid as the acid $R.CH_2.CH(CHO).SO_3OH$. This latter gives under suitable conditions a cyclic salt with aromatic amine bases, e. g.,



, which, contrary to the normal salt, has an intense egg-yolk color. The cyclic salt cannot be formed when tertiary bases, e.g., pyridin or quinolin, are employed. Quinolin hydrochloride produces indeed also a precipitate in a solution of lignosulphonic acid acidified with hydrochloric acid, but this precipitate is white and does not turn yellow secondarily.

The white precipitate first produced by, for instance, a naphthylamine salt is consequently the normal salt of the lignosulphonic acid, which later by ring formation transforms into the yellow cyclic salt in an acid solution. The ring formation occurs sometimes so easily in a strongly acid solution that it is unnecessary to remove the SO_2 loosely combined to the aldehyde group, but the ring formation then proceeds under liberation of SO_2.

We must now settle the question about the existence of this acrolein group in the whole infinite vegetable world. First, as to the trees I have made sulphite digestions with the woods of some of our more common trees, viz., spruce, birch, beech, oak, linden, alder, aspen and willow. It was found that the lignin could be extracted completely from all the different woods. From the solution cyclic, yellow β-naphthylamine salts could be obtained, having fundamentally the same appearance and properties as that prepared from fir. They could be prepared according to the same method, used in the case of the common waste liquor from fir wood.

The analyses of the naphthylamine salts gave the following results, calculated in percent:

	N	S
Spruce (Fichte)	2.07%	5.22%
Pine (Kiefer)	1.95%	5.34%
Birch	2.40%	4.84%
Oak	1.82%	5.02%
Aspen	1.87%	4.84%
Willow	2.04%	5.43%
Beech	2.00%	5.26%

The composition as to nitrogen and sulphur is consequently fundamentally the same for them all. Even if the lignin in these cyclic salts from all these different woods certainly is not identical, it is probable that it in all the cases is built after the same type.

The lignin is, however, also extracted from the herbaceous plants by means of sulphite digestion, and, as far as I have been able to ascertain, similar yellow cyclic aryl ammonium salts can be obtained from the solutions. These, however, have a fundamentally different composition, which will be shown more extensively at a later occasion.

We therefore obtain from the present rather incomplete investigation the opinion that the lignin reactions are due to the acrolein complex mentioned, which consequently for the present may be conceived as being as common as the lignin. This is especially true concerning the phanerogamous plants.

[8] Sv. Kem. Tidskrift 1917, 14.

[9] Ber. 53, 706 (1920).

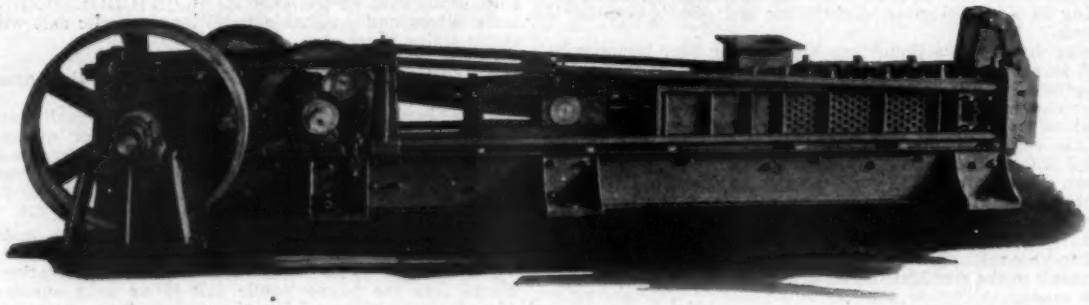
Report of the Committee on Sulphate Pulp

By Carl Moe, Chairman

Owing to the depressed business conditions there has been very little activity in the sulphate pulp industry during the past year. Most of the plants have been entirely or partly shut down. The stagnating condition created by this situation naturally has not been favorable to technical developments, and your committee has not been able to produce any papers for presentation at this meeting.

When the present committee had been appointed, some suggestions were made in the first report submitted to the association as to what phases of the sulphate pulp industry it would be worth while to investigate, in order to improve the process generally. The committee has endeavored to collect information along some of the lines indicated, and papers have been presented covering "Rinman Modification of Sulphate

THE GIANT NEKOOSA BARK PRESS



This machine, driven by a 25 H. P. motor, presses wet spruce bark 52% bone dry, and wet hemlock bark 49% bone dry. This refuse is thereby turned into a good, usable fuel.

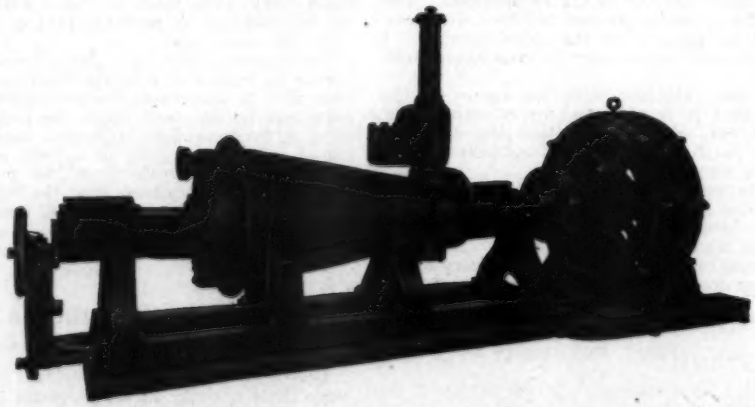
Nekoosa Motor & Machine Co.

Paper Mill Machinery, Iron, Brass and Sulphite Bronze Castings

NEKOOSA, WISCONSIN

E. D. JONES & SONS CO.

PITTSFIELD, MASS.



Jordan Engines, made in four sizes, either belt or direct connected motor driven

Manufacturers of

Paper Making Machinery

Process," "Elimination of Bad Odors from Digester Blow," "Evolution of Lime by Causticizing Test" and "Utilization of Lime Sludge as Fertilizer."

Inquiries made to the author of some of these papers by interested parties outside of the association seem to indicate that the attitude of the public toward the committee's work is appreciative.

There are, however, a good many other problems pertaining to the manufacture of sulphate pulp which profitably might be subjected to systematic research, of which the following may be mentioned as an example.

The so-called Kraft paper, which now absorbs a greater part of the output of the wood pulp made by the sulphate process, was originally made in the Scandinavian countries by under-cooking the pulp and disintegrating the fibre bundles by kollergangs. Later on kollergangs were abandoned and, with a somewhat more thorough cooking, the disintegrating and hydration performed by beaters, either of the ordinary type, or with bars made of basalt lava or special castings. A recent communication from Sweden, however, conveys the information that beaters, in turn, now have been abandoned for kollergangs, almost universally, in production of Kraft paper. This repeated changing forward and back between two so different systems, as far as can be judged, has been decided on for empirical reasons only, without any rational analysis of the factors involved. It would be greatly desirable to investigate systematically the effect of different kinds of beating as well as of different kinds of cooking on the hydration of the fibers and on the properties of the resulting paper, such as elasticity and resistance to bursting, tearing and folding.

Report of the Committee on Bibliography

By Clarence Jay West, Chairman

The Committee on Bibliography wishes to report progress in its work, though it feels that much more could have been accomplished had circumstances permitted. There is a feeling that the work of the committee would be more beneficial to the industry were the individual members of the association to constructively criticize it. The chairman would welcome this form of co-operation from any or all of the technical group.

The committee again wishes to call attention to the desirability of forwarding to the chairman copies of all printed matter relating to the paper industry. Only in this way can we hope to keep in touch with developments and pass this information on to those who can use it in their work.

During the past year contracts have been made with the larger number of the paper magazines through which the committee receives copies of the publications devoted to paper. This will enable the preparation of a much more complete biliography of paper making, a feature which it is hoped will be an annual compilation by the committee.

The committee wishes to take this opportunity of expressing their appreciation of the co-operation of these journals.

Inasmuch as these are really donated to the industry and not to the chairman personally, we wish to announce that beginning with January 1, 1922, copies of any of the following may be borrowed by any member of the Technical Association upon promise of return and payment of postage. Inquiries should be addressed to 1701 Massachusetts avenue, Washington, D. C.:

Paper Trade Journal. Paper, Paper Industry, Pulp and Paper Magazine of Canada, Paper Mill, The Paper Makers Monthly Journal, Papier, La Papeterie, Moniteur de la papeterie francaise, Svensk Pappers-Tidning, Papir-Journalen, Swedish Export, Papier-Zeitung, Papier-Fabrikant (Cellulosechemie), Wochenblatt für Papierfabrikation, Zellstoff und Papier, Pappen und Holzstoff Zeitung, Papier und Schreibwaren Zeitung, Boxboard, Carton Age, Fibre Containers, World's Paper Trade Review.

The publications of the committee for the past year (1921-1922) are as follows:

No. 25. Paper manufacture. A bibliography compiled by H. H. B. Meyer. Paper Trade J. 72, No. 13, 56-66; No. 14, 50-58; No. 15, 48-60 (Mar. 24-31, Apr. 7, 1921).

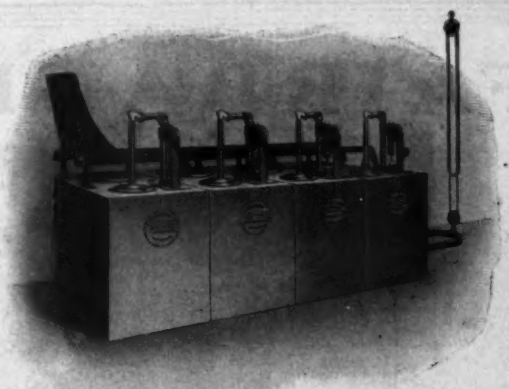
No. 26. Recent literature on the determination of cellulose. Compiled by Hottenroth; translated by Clarence J. West. Paper Trade J. 72, No. 17, 50-54 (Apr. 21, 1921).

No. 27. A bibliography of marbled paper. Dard Hunter. Paper Trade J. 72, No. 18, 52 ff. (Apr. 28, 1921).

No. 28. Reciprocity and the tariff in the paper industry. Clarence J. West. Paper Trade J. 72, No. 19, 48 ff. (May 5, 1921).

No. 29. The dyeing of pulp and paper. Clarence J. West. Paper Trade J. 72, No. 20, 46 ff. (May 12, 1921).

No. 30. Reading list on paper yarns and textiles. Clarence



Oils Can Deteriorate

Scientific Storage
Saves Money and Machinery

You would be surprised to know how great a saving is occasioned when a large user of lubricating oils abandons makeshift storing and adopts scientific TOKHEIM equipment.

First cost of the equipment is quickly cancelled.

It will pay you to read the facts on oil deterioration and waste under makeshift methods. Let us send you our bulletins.

TOKHEIM OIL TANK & PUMP COMPANY
1617 Wabash Ave. Fort Wayne, Indiana

TRADE JENKINS MARK Jenkins Bros

Jenkins Brass Y Valve

Particularly adapted for boiler blow-off service, and for handling the thick fluids consequent to paper making. The opening is nearly in line with the pipe, so that very little resistance is offered to the flow. Regularly furnished with Jenkins Composition Disc, and renewable seat ring. Made in standard and extra heavy patterns.

Fig. 124 Jenkins Standard Brass Y or Blow-Off Valve, screwed

Jenkins Valves are made in types and sizes for all requirements. The genuine are identified by the Jenkins "Diamond" and signature cast on the body. At supply houses everywhere.

JENKINS BROS.
New York, Philadelphia, Boston, Chicago, London, Montreal

Jenkins Valves
SINCE 1864

FAIRBANKS SCALES

This Dial Scale Gives Quick, Accurate Weights in a Paper Mill—

Hardly a chance for errors — the exact weight is shown in plain figures on a large dial. Loads can be weighed as fast as they can be moved on and off the platform.

All metal, self contained and built on the suspended platform principle which assures constant accuracy and sensitiveness—no scraping of knife edges and pivots.

Fairbanks, Morse & Co.
INCORPORATED CHICAGO

Oil Engines - Pumps - Electric Motors and Generators - Fairbanks Scales - Railway Appliances - Farm Power Machinery

The BLACK-CLAWSON Co.

HAMILTON, OHIO

Builders*—Paper and Pulp Mill Machinery—*for

INCREASED PRODUCTION **SERVICE ALWAYS**

J. West. Paper Trade J. 72, No. 22, 42 ff. (May 26, 1921).

No. 31. Clay in the paper industry. A reading list compiled by Clarence J. West. Paper Trade J. 72, No. 23, 52 ff. (June 2, 1921).

No. 32. Special Papers. III. Cigarette paper, a reading list. Clarence J. West. Paper Trade J., No. 25, 44 ff. (June 16, 1921).

No. 33. Paper Research Literature. VIII. The work of C. F. Cross. Arranged by Clarence J. West. World's Paper Trade Rev. 75, No. 4, 338 (Jan. 28, 1921); Paper Trade J. 73, No. 3, 46 ff. (July 21, 1921).

No. 34. Sulphate pulp and kraft paper. List of references covering the literature up to 1912. Clinton K. Textor. Paper Trade J. 73, No. 4, 46 ff.; No. 6, 46 ff.; No. 7, 54 ff. (July 28, Aug. 11-18, 1921).

No. 35. Recent literature on soda and sulphate pulps. Clarence J. West. Paper Trade J. 73, No. 16, 46 ff.; No. 17, 42 ff. (Oct. 20-27, 1921).

Earlier contributions of the committee are listed in the report for 1921, copy of which will be sent upon request.

Kalamazoo Convention

To Be Held Jointly by Superintendents and Cost Association of the Paper Industry, June 1st-2nd-3rd, 1922

The plans for the above convention are fast taking shape and it is becoming apparent daily that it will be attended by men really representative of the industry's best interests.

Mr. W. J. Raybold, president of the American Paper and Pulp Association, has already consented to make the opening address and will be followed by Mr. J. Kindleberger of the Kalamazoo Vegetable Parchment Company, in whose new Community House the opening Luncheon will be held. These speakers will be followed by Dr. Hugh P. Baker, executive secretary of the American Paper and Pulp Association, and by Mr. Galliver, president of the American Writing Paper Company, who will have a very direct message to give to the superintendents and cost men regarding his views on the necessity for proper co-operation between these two most important departments of every paper mill. These four speakers alone are well worth going a long way to hear. They will be followed by practical accountants including Mr. C. Oliver Wellington of the firm of Scovell, Wellington & Co. and by Mr. F. W. Figsby of Messrs. Ernst & Ernst. Following these, papers will be read by some of the best known practical pulp and paper cost accountants in the industry. These addresses will be short but to the point and following them the meetings will be thrown open for full discussion from the floor of the various problems put forward regarding the best methods to be adopted in order that full and proper co-operation between the superintendents and cost departments may be fostered in the most practical manner.

Registration will take place at the New Burdick Hotel, Kalamazoo, Mich., June 1st at 9:00 A. M. for the Superintendents' Association and at the Park American Hotel for the members of the Cost Association. Following registration at 10:30 A. M., business meetings will be held separated by each association at the hotels in which registration takes place. A joint luncheon will be held at 1:00 P. M. at the New Community House on the Kalamazoo Vegetable Parchment Company's premises, when addresses will be made by the above mentioned speakers, following which the meetings will be thrown open for general discussion. A banquet will be held in the evening at 7:00 P. M.

On Friday, June 2, separate meetings will be held by the two associations and another joint meeting in the afternoon, when it is proposed to draw up a set of recommendations regarding co-operation between the superintendents and the cost departments. These will be in the form of a resolution put to the meeting, and it is hoped that following the convention all those attending will be boosters for these recommendations, which will, if carried out conscientiously, benefit the industry tremendously, because they will strengthen one of the weakest spots at present existing in many pulp and paper mills. It can thus be seen that those attending this convention will have an important work to do and should come prepared to contribute to the discussions which will take place.

With all the care in the world, it is not possible for the cost department to compile correct cost figures if the information received from the mill is incorrect, and on the other hand, it is not possible for the superintendent, no matter how good his intentions may be, to assist the cost department in obtaining correct information if he himself is not "sold" on the necessity for collecting it, nor advised regarding the proper methods for doing so. It is for the purpose of promoting a better understanding generally between superintendents and

Increased handling capacity at one-half the cost

To double your handling capacity and at the same time cut the unit cost in half is certainly worth while. The Brownhoist locomotive crane shown above is doing this at the paper mills where it is working. This crane handles 85 thousand feet of timber per day at a cost of 70 cents per thousand. This is against 45 thousand feet at a cost of $1.48 per thousand under the former method.

In addition to the speed and low cost of upkeep of Brownhoist cranes their great flexibility should be considered. Practically all kinds of materials can be handled anywhere as Brownhoists are made to operate on traction wheels or creeper trucks as well as railroad trucks. And the saving of handling materials by locomotive crane is usually as great or greater than the above.

Catalog K shows many types of Brownhoist cranes working in different industries. If you have any handling problems you will be interested in seeing how some Brownhoist owners are solving theirs. Write us. The knowledge of 40 years of crane building is at your service.

The Brown Hoisting Machinery Co.
Cleveland, Ohio

Branch Offices, New York, Pittsburgh, Chicago, San Francisco and New Orleans

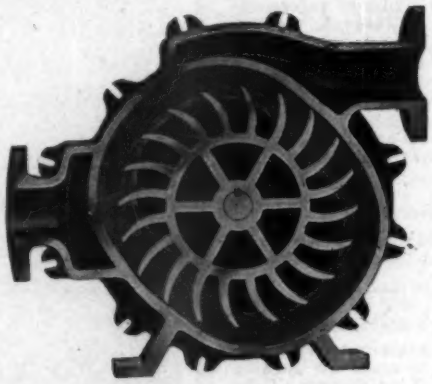
BROWNHOIST

THE HYTOR VACUUM PUMP FOR FLAT BOX SERVICE

Vacuum Produced Absolutely Without Pulsation

No Vibration

Saves Wires



Only One Moving Part

No Rods, Pistons, Crank Shafts, Loose Moving Parts, and No Gears

No Expert Attendance

Western Representative
T. H. SAVERY, JR.
1718 Republic Bldg.,
Chicago, Ill.

The Nash Engineering Co.
WILSON POINT ROAD
SOUTH NORWALK, CONN.

New England Representative
G. H. GLEASON
185 Devonshire St.
Boston, Mass.

PAPER Men Told Me I Ought to Advertise This

As you know, the Neenah Brass Works does a great deal of work for paper mills. In studying acid-proof metals and repairing valves, etc., I hit upon a new type.

"Great!" a local paper mill man I knew said, "Give us one." It worked like a charm, making him a lot of money.

Then I received orders for valves from his friends in the business. Whenever mill men by chance happened to see it, they ordered one. "You ought to advertise that blow-off valve of yours," I was told. So here it is. It has made money in every mill it has been placed in. I think it will in yours.

Tear off this coupon and mail it, and I will give you all the facts. Better still, give me some dope about your mill, and I'll figure out for you what it will do. There the coupon is—in the lower right-hand corner.

Henry Horkman
The Neenah Brass Works
Neenah, Wisconsin

The Horkman
Improved Safety Blow-off Valve
Made in 8, 10 and 12 inch sizes. Blueprints and specifications furnished upon application.

HENRY HORKMAN,
Dept. 45,
Neenah Brass Works, Neenah, Wis.
Tell us about the Horkman Safety Blow-off Valve.
Name .....
Address .....

cost accountants that this convention is being held, and it is in the interests of all mill executives to see that their superintendents and cost accountants attend this convention and do their bit in making it a success by stating their difficulties and particularly their suggestions for improving the methods of collecting information from the mill workers.

As competition becomes keener, the necessity for saving becomes more apparent, and if superintendents will stand squarely behind the cost departments and see that they are supplied with correct information there is not the slightest doubt that in many mills very important economies will result.

Reservations should be made promptly through Mr. Harry C. Bradford, the Cost Association's local secretary at Kalamazoo, Mich., and addressed to him at 1420 Bank street, Kalamazoo. Any further information required can be obtained from the Cost Association of the Paper Industry at 18 E. 41st street, New York City.

Plans of T. A. P. P. I. for the Year

The executive committee elected at the annual meeting held its first meeting at Woronoco, Mass., on May 4 and 5, to formulate its plans for the coming year. Chairmen of the standing committees were selected and suggestions made as to the activities desired on the part of each committee. For the committees on the manufacturing processes it was recommended that at least two lines of work be undertaken, one along research investigation (such as in sulphite the value of estimating the alpha, beta and gamma cellulose as a practical method of establishing quality, and the factors affecting the content of each), and the other of a process nature of directly practical value.

In view of the need for lowered costs of manufacture, it is believed that the work of the committees with the hearty co-operation of the members and their companies will have a very beneficial effect on the industry. During the past month the Technical Association sent out to each of its members a request for an expression of desire or willingness to serve on some particular committee or to co-operate in its work. While a number have so indicated, there is still a large proportion to be heard from. The executives of the paper and pulp manufacturing concerns should ascertain how their companies are represented in the membership of the Technical Association and encourage the co-operation of their plants in the work undertaken.

It is likely that two specific investigations will be begun this year in addition to those already started. In the past year beginnings were made on the drying operation and on beating, which will be continued. The new projects contemplated are on drum barker waste and on mill effluents. The former is still regarded as a problem, particularly to mills in northern United States and Canada. The latter is a problem as broad as the industry and is likely to become more acute as time goes on.

The work to be undertaken by the Technical Association will be watched with interest.

Some Abstracts of Chemical Papers

Following are three abstracts of papers that were given at the Spring meeting of the American Chemical Society in Birmingham, Ala., April 4th to 8th.

Some Observations on the Determination of Cellulose in Woods

By S. A. Mahood

In a previous communication the author showed that the yields of cellulose from woods obtained by Schorger's modification of the Cross and Bevan method of cellulose determination are higher than those obtained by Seiber and Walter's modification. It was suggested that this difference might be due (1) to a difference in concentration of the chlorine in contact with the sample or (2) to a difference in temperature at which the chlorinations are made.

The present paper covers an investigation of these two points. It has been found that the yield of cellulose obtained by the Sieber and Walter method of chlorination can be made to accord with that obtained by the Schorger method by diluting the chlorine used with an equal volume of air. There appears to be no difference in the percentage of cellulose obtained by the Seiber and Walter method when chlorination takes place at zero and at room temperature.

The Willard crucible has been found to be more suitable than the Gooch crucible with the fiber pad, as proposed by Seiber and Walter, for making chlorinations of cellulosic materials.

The results show that the lower yield of cellulose obtained by the Seiber and Walter method of chlorination is due only

WE EXTEND TO ALL PAPER MILL MEN A CORDIAL INVITATION TO VISIT OUR PLANT WHERE WE SPECIALIZE IN THE BUILDING OF A WIDE AND VARIED LINE OF SLITTING AND ROLL-WINDING MACHINES WHICH MAKE POSSIBLE THE REALIZATION OF THE MOST EXACTING STANDARDS OF MODERN REQUIREMENTS AS TO SPEED, ACCURACY AND ECONOMY OF WASTE.

WE HAVE BROUGHT TOGETHER IN OUR SHOW ROOM SPECIMENS OF THE WORK DONE ON OUR MACHINES WHICH CONSTITUTE A RECORD OF COMMERCIAL AND MANUFACTURING NEEDS FOR GOODS IN ROLL FORM. AN INSPECTION OF SAME WILL SUGGEST NEW APPLICATIONS AND NEW MARKETS FOR YOUR PRODUCTS, AND NEW WAYS OF UTILIZING YOUR BY-PRODUCTS.

WE PLACE AT YOUR SERVICE THE EXPERIENCE GAINED BY MANY YEARS DEVOTED SOLELY TO THE DEVELOPMENT OF MACHINES AND PROCESSES FOR CUTTING AND ROLLING EVERY SORT OF GOODS USED IN THE FORM OF ROLLS OR COILS.

CAMERON MACHINE CO.
BROOKLYN, N.Y.

This style machine slits and rewinds all kinds and thicknesses of paper from tissue to box board—filled and gummed stock, and combined cloth and paper.

THIS, THE BEST Paper Mill Slitting & Rewinding Machine

Handles a mill roll up to 40 inch diameter and rewinds on one shaft up to 40 inch in diameter.

The paper is rewound by the use of three rolls; the top roll by its pressure gives compactness to the rewound paper roll and makes it easy to handle the poorest grades of paper without breaking. That serious defect in some machines arising from a one-side drive for the top pressure roll is wholly overcome by our double drive which gives uniform bearing on the rewound roll. This top pressure roll is easily and quickly raised for changing the roll by turning a crank. Counterweights can be increased or decreased in weight according to requirements.

Another prominent feature of this machine is its convenience. It has a device for separating the slitting cutter shafts to facilitate threading the paper through the machine. All adjustments necessary are made from the operator's place which is at the rewinding end of the machine.

The slitting cutters which are on parallel shafts give a clean, shear cut. The cutters may be quickly adjusted to different widths from 1¼ inch upward, and are clamped to the shafts with ample bearing surface so that they always run perfectly true.

MEISEL PRESS MFG. CO.

944 Dorchester Ave. BOSTON 25, MASS.

GROUND WOOD
CHEMICAL PULPS

PERKINS-GOODWIN CO.
NEW YORK

PAPER

to too concentrated a stream of chlorine and not to too high a chlorination temperature.

Some of the Products Obtained in the Hydrolysis of White Spruce Wood with Dilute Sulphuric Acid Under Steam Pressure

By E. C. Sherrard and O. W. Blanco

A study of products formed in the hydrolysis of wood and wood cellulose has furnished valuable information concerning this reaction and the composition of these two substances.

Approximately 20 per cent of the wood cellulose is hydrolyzed with the formation of mannose, glucose, galactose, xylose and arabinose. Mannose and glucose represent nearly two-thirds of these sugars.

Spruce cellulose prepared by the Cross and Bevan method yields mannose, glucose and pentoses on hydrolysis with dilute hydrochloric acid. This indicates a marked difference in the chemical constitution of wood cellulose and of cotton cellulose. The latter does not yield mannose or pentose sugars on hydrolysis.

Sugar Formation in a Sulphite Digester

By E. C. Sherrard and C. F. Suhm

This paper contains charts showing the rate of formation of sugar during the conversion of white spruce into sulphite pulp by the Mitscherlich and Ritter-Kellner processes. Time and steam pressure appear to exert the greatest influence on sugar formation.

Will Address Local Division of the Cost Association of the Paper Industry

Mr. E. H. Naylor, secretary-treasurer of the Writing, Book, Cover and Tissue Associations, well known as the author of "Trade Associations" has kindly consented to address the Connecticut Valley Local Division of the Cost Association of the Paper Industry at Holyoke, Mass., on or about May 22d next.

Mr. Naylor, it need hardly be said, is a very good speaker and will have some very interesting things to say regarding Association work and cost work in particular. While he is not a practical cost accountant, he has made a study of the subject during his many years connection with the pulp and paper industry, as is indicated in his book and, therefore, the officers of this Division sincerely hope that as many members as possible will arrange to attend this meeting and make it one of the most successful yet held in Holyoke.

New England

Boston, May 1.

Since the last New England report was written there has been material improvement in the fine paper mills of New England. Among the larger mills this is especially true for the conditions seem to favor the well known and widely distributed mill brands, in view of the extensive advertising through metropolitan dailies and national weeklies that many of these already famous watermarks and brands are getting.

For instance, the American Writing Paper Company, which on January 1 was running its 26 mills at approximately 60 per cent of capacity, is today turning out paper at the rate of 80 per cent capacity operations, and with a new and aggressive advertising campaign on their famous Eagle A papers should easily hold this pace, if not shown even larger production in May.

Catalogue work has been very extensive in New England and has been of no little help in absorbing a substantial part of the greater production this spring. The mills themselves have all marked inventories to the bone and therefore, based on current raw material costs, many if not a majority of them are making a small profit, enough at least to meet funded debt requirements and leave a small residue for preferred and common shares. It would probably be no exaggeration to say that New England paper mills are paying 4 per cent on common stock today, or at least are earning that much, taking the industry as a whole.

From such a broad statement however, specific lines such as the board mills should be excluded. The paper board manufacturers in this section as, we understand, in other sections continue to be hard hit. Frequent shutdowns ostensibly for "repairs" but usually for a lack of orders characterize the current situation in paper boards. Demand is much less than enough to enable the mills to operate at capacity. Idle mills certainly pay no dividends, and though a mill now and then runs full for a fortnight it is always followed by 50 per cent operations or a week of inactivity.

The price of chip board in New England has been as low as $32.50 per ton delivered consumer's shops, but this board has been produced in small mills, usually in insufficient amounts for the large shoe or candy box makers. The stand-

Cleveland
WORM GEAR
REDUCTION UNITS

Cleveland Worm Gear Reduction Unit applied to mill line shaft. Motor 400 H.P.

The Vital Points in Worm Gearing

We believe that we are building the finest Worm Gearing in the world. Back of our confidence in that statement is a specialized knowledge concerning worm gearing, its manufacture and its uses, that is unique in American industry. The points that make "Cleveland" worm gearing preeminently the highest grade gearing extant are:

(1) Correct design which requires understanding of the basic principles involved in modern worm gearing.
(2) proper materials and tooth contact
(3) superior method of cutting
(4) correct mounting
(5) proper lubrication

When these points are fully covered as in Cleveland Worm Gearing, efficiency is constant. Quietness is certain. Low maintenance cost is assured and the even torque in many cases means a much better product.

Naturally each problem is different. Each installation has its own peculiarities. Yet, because of this very fact, our engineering department has acquired a fund of reliable data that is immensely valuable to our customers. This service is yours when you desire it. Write us.

The Cleveland Worm & Gear Co.
America's Worm Gear Specialists
CLEVELAND, OHIO

DRAVO-DOYLE COMPANY
Pittsburgh, Cleveland, Indianapolis, Philadelphia

New England Representatives
FRANKLIN MACHINE CO.....Providence, R. I.

Pacific Coast Representatives
ALFRED H. COATES CO.....San Francisco, Cal.

Rocky Mountain States Representatives
THE VULCAN IRON WORKS CO.....Denver, Colo.

A Complete Line of

Powder-Packed Renewable Fuses

It has been recognized by the highest engineers as the proper fuse design—only such a design can give positive yet economical protection. The Federal-National powder-packed renewable cartridge fuse, safe, economical, absolutely reliable for D. C. and single phase protection. (Shown on the right.)

FEDERAL National MULTIPHASE TIME LIMIT · POWDER PACKED RENEWABLE FUSE

FEDERAL National TIME LIMIT · POWDER PACKED RENEWABLE FUSE

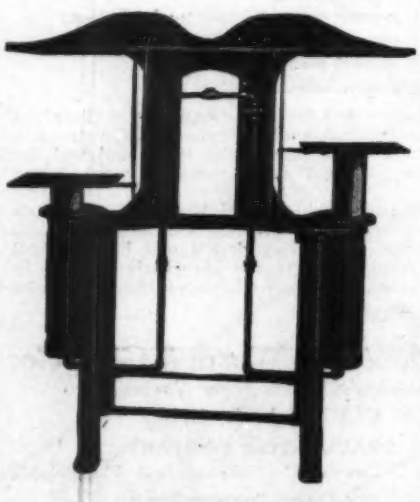
Federal-National Multiphase Time Limit Powder-packed Renewable Fuse. The only absolute protection for multi-phase motors and circuits.

FEDERAL "THREE-THIRTY" TIME LIMIT · POWDER PACKED RENEWABLE FUSE PLUG

The Federal Three-Thirty Powder-packed Time Limit Renewable Fuse Plugs, National Cartridge Type for small motors, heating apparatus, mercury arc lamps and rectifiers.

Federal Electric Co.
8700 South State Street
CHICAGO, ILL.
130 West 42nd Street, New York City
91 New Montgomery St. San Francisco, Cal.
BRANCHES IN ALL LARGE CITIES

Soft Toilet Roll Rewinders



For rewinding or tightening Soft Toilet Rolls. Automatic in action, grip core firmly. Winds from center of roll. Starts quick, stops quick. Makes Semi-Hard rolls from loose rolls.

Pneumatic Double Package Press

For putting up napkins, tablets and pads in neat packages. Action quick and positive. Easy to operate.

Write for New Catalogue "Paper Machinery"

HUDSON-SHARP MACHINE COMPANY
GREEN BAY, WIS.
GIBBS-BROWER COMPANY, Selling Agents, 261 Broadway, New York, N. Y.

ard price on chip here as elsewhere in the country has been $35.

The wrapping paper mills continue to sell kraft paper of No. 1 quality at 7 to 7½c f. o. b. the mill, and though demand has been hardly enough to keep mills in continuous operations there has been no disposition to cut that price which is described as nearly bedrock.

Paper Mill Supplies

The supply market awaits the reduction of present mill stocks. It must meanwhile depend on small orders to maintain prices. Rags, chemicals, coal, and waste papers are moving in a slow and desultory fashion to the mills, for while activity generally has shown an increase, the mill supply market has not felt the reaction. The prophets who predicted no fuel shortage for at least three months, are still in good standing, for nothing has happened to detract from their reputations since the coal strike started. New River and Pocahontas coal is selling at $6.25 on the cars in Boston, which is practically the same quotations that existed previous to the outbreak of hostilities at the mines.

But the same sort of indifferent buying, characterizes the rag market. New shirt cuttings, have been in consistent demand, and specially prepared packings of No. 1 old whites have been selling quite well, but in most instances, including that of the latter grade, paper stock packers have through the keen competition that exists, been forced to shade their prices more than once. For this reason it is not strange to find No. 1 old whites selling at 5¾c to 6c delivered the mill. White shirt cuttings have been bought at 9 to 9½c at the mill.

The mills are consuming relatively fewer linen rags at present than early in the year owing to the slack conditions prevailing at two of the chief consumers. Prices on that class of stock are firm, however, owing to the light supply that is coming out of Germany, which with France, is the chief source of supply for that material.

Rope has been firmer of late, and has sold at 4½c to 4⅝c f. o. b. shipping point. On the other hand No. 1 bagging has been in very light demand and has been obtainable at $1 delivered mills. Buying of mixed strings is at the wide range of 90c to $1.20 delivered varying according to freight rates.

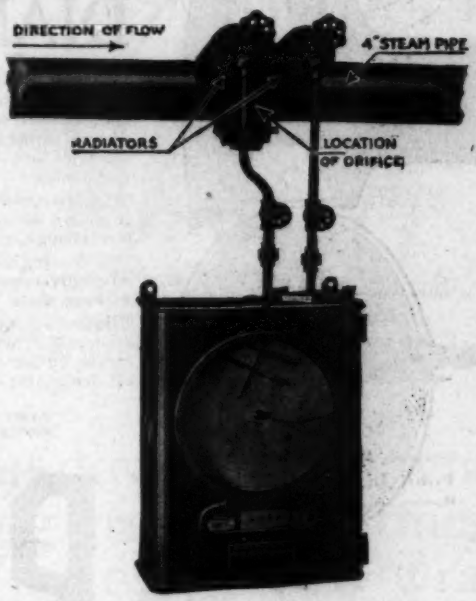
The last import figures for which we have any record in Boston are for February, which showed imports of cotton rags during that month of 1,694,000 pounds, from England, Scotland, Holland and Germany, and of ropes, and waste paper, etc., of 1,645,000 pounds. These are department of Commerce figures and show a steady continuance of importations. Newsprint imported during that month from Germany through Boston, presumably for Hearst's Boston American, amounted to 3,436,000 pounds, valued at $128,000. During the same month there were 4,436 tons of unbleached sulphite imported, principally from Sweden, valued at $264,000; same 425 tons of unbleached sulphate valued at $23,000; 4,363 tons of bleached sulphite valued at $353,678, or slightly over $80 per ton for the latter. This is in line with current quotations of about 4c per pound for good Swedish and Norwegian bleached sulphite pulps. Although importers are quoting close to 2.50 c. i. f. North Atlantic ports for kraft pulps, a fair No. 1 pulp was sold in Boston very recently at 2.20c per pound on the docks.

Bangor, Maine, men are interested in a new waterpower development which is expected to furnish power to the Advance Bag and Paper Company's plant at Howland, Maine. The first step was the formation of a corporation on April 24, under Maine laws, with a capitalization of $100,000 of which 500 shares is paid in the par value of the shares being $100. The corporation is located at Howland and the directors are John Mullen, James D. Rice and James Mountaine, the latter, president and treasurer. The company will be known as the Penobscot Power Co. The Advance Bag and Paper Company's Howland mills which have recently been enlarged, were formerly the Howland Pulp and Paper Company, having been purchased by the Advance Company about a year ago. They are expected to consume 3,000 horsepower.

Interesting Map Published by Paper Association

Considerable interest is being aroused in New England over the proposed rate adjustments, which will enable paper manufacturers to reach certain markets in the northeastern part of the country at a considerable saving over present freight rates. The matter relates chiefly to the New England railroad rates on finished paper and paper board, rates which at present discriminate against certain mills and favor others. Naturally the railroads wish to adjust rates in such a manner so as to result in no net decline in their revenues and this

Bailey Fluid Meter



PRACTICAL —— ACCURATE

This shows the Bailey Fluid Meter complete for the measurement of steam. It consists of the Monel metal orifice installed between a pair of flanges, radiators and valves tapped into the pipe on the inlet and outlet sides of the orifice and pipes connecting these to the recorder.

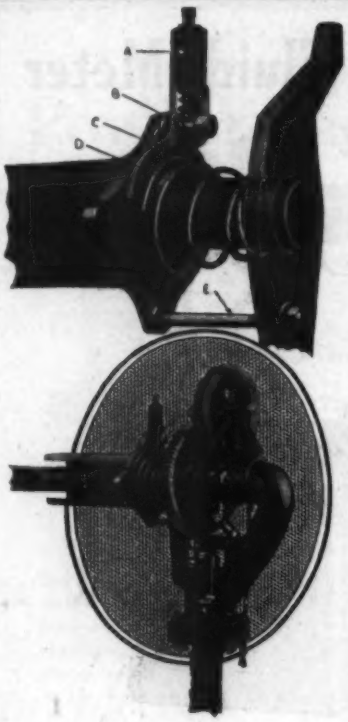
Bailey Fluid Meters are easily and cheaply installed as changes in piping are not required and the accuracy is guaranteed.

They are the most practical and satisfactory meters for recording and integrating the flow of steam to turbines, digesters, paper machines and other processes. Steam can be measured at any pressure and temperature, exhaust steam included.

Either pressure or temperature recorders, or both, may be added to record on the same chart as the rate of flow.

Our engineering department is ready to suggest the proper equipment for your service.

The BAILEY METER COMPANY
2023 East 46th Street, CLEVELAND, OHIO



Floating Features of DIAMOND VALV-IN-HEAD SOOT BLOWERS

One of the most important factors in the success of the Diamond Valv-in-Head soot blower is the floating mechanism which provides a means of taking care of any shifting of position of the blower element without causing dislocation of the wall box, cracking of brick work, or expansion strains on soot blower head and piping.

The Diamond floating mechanism reduces possible binding to a minimum, as it allows the soot blower to move parallel with the wall sufficiently to overcome any change in relative position of wall and bank of tubes.

The floating mechanism is also a direct means of support for the blower element, any movement being taken up by the spring "A" inside of the cylinder. The floating plate "C" serves as a seal to exclude air from the setting.

Elimination of binding of units is only one of eleven important advantages of Diamond Valv-in-Head soot blowers. Others include 50 per cent saving in steam, 50 per cent saving in labor, 60 per cent saving in pipe and fittings, greater efficiency, etc.

Every boiler needs a mechanical soot blower and you will save money by buying the best. Ask for your copy of Bulletin 297, describing the new blower.

DIAMOND POWER SPECIALTY CORPORATION
Detroit-Michigan

Diamond
VALV-IN-HEAD SOOT BLOWERS

PUMPS

Chinese rice-fields are dotted with these curious "pumping stations."

BECAUSE his rice-fields were always calling for water, the Chinaman was forced to become something of an engineer. Not only did he invent a number of different pumps, but he also developed primitive "pumping stations," oxen and cog-wheels supplied the necessary power.

CENTRIFUGAL PUMP

Whenever—today—you run across difficult pumping problems, you will find American-Marsh Pumps on the job. Our Centrifugal Pumps (as is the case with all American-Marsh Pumps) are simple, reliable and efficient.

WRITE FOR BULLETINS

American Steam Pump Co.

BATTLE CREEK, MICH.

Chicago Office
1220 Monadnock Block

New York Office
17 Battery Place

The American-Marsh line includes Power Pumps, also Boiler Feed Pumps, Centrifugal Pumps, Air Compressors, Vacuum Pumps, Condensors, Deep Well Engines.

it is difficult to do without advancing unduly low rates, the beneficiaries of which strongly oppose the removal of such advantages. Further developments are looked for in this matter, under the able leadership of the New England Paper and Pulp Traffic Association. This latter Association has just completed a most interesting map of the paper trade of the United States east of the Mississippi River and North of the Virginia-Carolina line. The map is an improved edition of one which was published some four years ago; shows the towns in the United States where a paper mill is located and on one side of the map is listed the total productions of paper and board in these towns. It is of large, wall size and will make an attractive and valuable addition to any paper mill superintendent's office, or the office of a paper traffic manager, a paper mill supply house or to the city office of a mill.

The Inland Paper Board Company is a new organization formed at Norwich, Conn., to operate the paper board mill in the nearby village of Versailles, a plant formerly controlled by the Federal Paper Board Company, of New Jersey. The new concern, it is stated, has no connection with any other paper board manufacturing concern. Its property is on the New York, New Haven and Hartford Railroad, and includes 620 acres of land, a modern two machine paper board mill, ample mill yards and dwellings. A considerable portion of the product is used by the Atlantic Carton Corporation in Norwich. The company's directors are William G. Shortess, Frank Mousley and H. T. Brown, and the financing includes the issuing of 3,000 shares of preferred, of $100 par value, and 8,000 shares of common stock, no par value.

Water shipments of paper from Portland, Maine, to the Pacific coast which were recently started may develop into quite a satisfactory method of shipping to the Pacific coast. Several intercoastal steamship lines having Boston and Portland on the Atlantic coast and Los Angeles, San Francisco and Seattle on the Pacific coast and ports of call have taken part in these shipments. It is rumored that the St. Croix Paper Company of Woodland, Maine, and mills of the International Paper Company in the same state took part in shipping 5,000 tons of newsprint in this way to Los Angeles publishers at a saving of some $2 a ton in the all rail rate over the continent.

The Pejepscot Paper Company is speeding up work at its Bath, Maine, unloading piers where it is bringing its pulpwood supply in from northeastern Maine and the Maritime Provinces of Canada. The Bath unloading equipment was recently moved there from Belfast. The company runs a line of barges and towboats to its sources in the north, and unloads at Bath, from whence the logs are hauled by rail to the mills. The company expects to accumulate some 15,000 cords before next winter. The first craft of any kind to be launched in Maine this year was the harbor barge, S. T. Co. 8, built for the Pejepscot Paper Company to haul pulpwood.

The big machine at the Bird & Son mill at East Walpole, Mass., is being altered and extended to give it a production nearly fifty per cent greater than at present. This mill makes paper board. It is reported that over a million dollars has been spent on improvements at the mills since the first of the year.

S. Silberman & Company, of Cleveland, Ohio, a paper stock dealer has opened Boston offices at 136 Federal street. Their eastern business in rags, waste papers etc. will be largely handled from this office.

Miami Valley

Dayton, May 1.

H. S. Taylor, Ltd., of Montreal, Quebec, associated with the management, Engineering and Developing Company of Dayton, Ohio, has started work on the erection of a paper mill for the Provincial Mills at Port Arthur, Ontario. The estimated cost of the building according to officials is $1,500,000.

The new mill will be of concrete, steel and brick. It will be designed and built entirely by the local corporation. The mill site is directly on the shore line of Lake Superior and is ideal both from a manufacturing and construction standpoint.

COPYRIGHTED

Cut down *excessive* wrapping paper investment. Why carry two wrapping paper lines for one wrapping paper *purpose?*

MOSINEE

presents a perfect wrapping paper, weight and strength for each wrapping purpose. Made in all weights from 15 pounds to 100 pounds basis. The one complete, standardized and economical line of wrapping paper sold.

Mosinee Kraft

"The Wrapper that Delivers the Goods"

DIAMOND ALKALI COMPANY

MANUFACTURERS OF

Soda Ash 58%

Modified Sodas

ALKALI

Caustic Soda 76%

Special Alkalies

BICARBONATE OF SODA, U. S. P.

Our complete Works, located at Painesville, Ohio, directly situated on three Trunk Line Railroads, are in position to serve you to advantage.

Address inquiries and communications to our general offices at

PITTSBURGH PENNSYLVANIA

Appleton

Felts & Jackets

We have for a long number of years furnished felts for some of the largest pulp, board, news and writing mills in the country.

Manufactured By

APPLETON WOOLEN MILLS

APPLETON ·· —— ·· WISCONSIN

A purification plant which will do away with the stream pollution from the Hagar Straw Board and Paper Company at Cedarville, Ohio, has been installed and is expected to solve the problem which has troubled officials of the plant and the State Game Bureau for many years.

With the installation of the new purification system, the upper stretches of Little Miami river will be free from pollution for the first time in many years. Other methods used by the company in an effort to purify the water have proved futile.

The Miami Paper company, a corporation of West Carrollton, Ohio, was sued for $114,873.15 by Warren D. Spengler, a mechanical and construction engineer of Cleveland, Ohio.

He claims he was employed by the company in 1920 to draw plans and specifications and to supervise the erection of factory buildings and their equipment.

J. M. Mahoney, for the past four years connected with the Chicago Mill and Lumber company, has accepted a position at the Champion Coated Paper Mills in Hamilton, Ohio, as manager of Paper stock department.

The Largest Toilet Paper Factory in the World

The largest exclusive toilet paper manufacturing plant in the world is that of the A. P. W. Paper Company, of Albany, N. Y. The factory is located in the northern suburb of Albany on the bank of the Hudson river, thus providing excellent facilities for power as well as shipping by either rail or water.

The Liberty Mill, where the initial processes of paper making is carried out, was recently erected. It is equipped with specially designed machinery which has extraordinary capacity for high speed and quantity production. Even the pulp wood used in the manufacture of the paper is shipped in from the spruce forests in Vermont, owned by the company, and is ground at the mill. This mill can produce one thousand tons of paper a month.

This paper, in huge jumbo rolls, is carried from the Liberty Mill to the converting plant by a fleet of four motor trucks. Here it is made into rolls and packages of toilet paper and paper towels and packed ready for shipment. In this plant, as in the Liberty Mill, the machinery is specially designed so as to insure a product of even quality at minimum production cost.

The result is that the A. P. W. Paper Company is able to place on the market a superior quality of toilet paper at the same relative cost to the consumer as that of the inferior grades.

Some of the well known and popular brands of the A. P. W. Paper Company product include A. P. W. Satin Tissue, Pure White, Cross Cut, Fort Orange, Bob White and the Onliwon Toilet Paper and Towels. The company has developed a system in the manufacture of their toilet paper that insures the highest degree of hygienic results. Nothing but pure wood pulp is used, and waste and print paper is not in any degree a part of the product. The mills are kept in the most sanitary condition possible by the use of modern and up-to-date equipment, and the product as placed on the market is claimed by its manufacturers to have no superior and few if any equals.

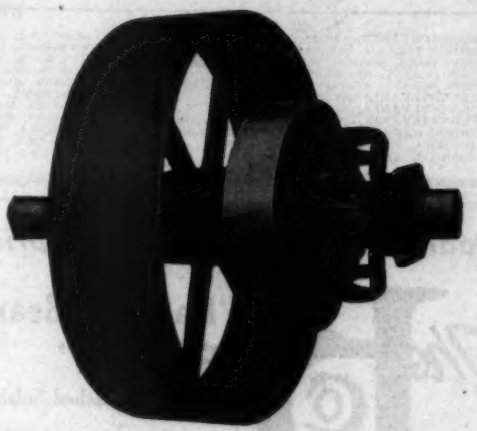
Over Capacity in Paper Mills

In a summary of the developments of the recent convention of the paper manufacturers at New York, the American Paper and Pulp Association in a bulletin to its members makes the following comment:

"One of the interesting developments of the situation in the paper industry following the annual convention has been the discussion of the capacity situation of the industry with reference to the current demand for the finished product. It was brought out during the week that the over-extension of the industry is one of the greatest problems which has to be faced. At the best, before the war, the mills were operating at about 80 per cent of total capacity, the demand never coming up to the potential supply.

"The discussions during the convention showed that since the war there have been 120 machines placed in commission, increasing the capacity 23 per cent. The growth of the demand in normal times is about 200,000 tons a year, and at this rate it would take at least three years to get back to the pre-war basis, presuming no new machines were added. To reach a normal operating basis of 90 per cent would take until 1928, these discussions brought out.

"This means according to leaders in the industry, that new uses for paper must be found, and new markets developed."



UNIVERSAL GIANT

A Thoroughly High Grade Friction Clutch

The Universal Giant is a thoroughly modern, high-grade Friction Clutch—compact in form, unusually strong, easily applied and readily adjusted. It is complete within itself and does not require specially constructed appliances to be fitted to it.

Being made with an extended sleeve of standard diameter, an ordinary pulley, gear, rope sheave or sprocket of regular dimensions can be used by simply keying it on sleeve of clutch. It is only necessary that bore be the same as diameter of sleeve.

May we send you our catalog?

It contains some interesting and useful data on POWER TRANSMISSION APPLIANCES and the problems which beset the user.

T. B. WOOD'S SONS CO.
CHAMBERSBURG, PA.

POWER TRANSMITTING MACHINERY

THE GUARANTEED
CORLISS VALVE STEAM TRAP

PLANT ENGINEERING & EQUIPMENT COMPANY
68 SUMMIT STREET, BROOKLYN, N. Y.
POWER PLANT EQUIPMENT, PUMPS, AIR COMPRESSORS, ETC.

BRANCH OFFICES

MASSACHUSETTS, Boston, 10 High Street
RHODE ISLAND, Providence, 511 Westminster Street
NEW YORK, Syracuse, 445 So. Warren Street
NEW JERSEY, Newark, 845 Broad Street
NEW JERSEY, Atlantic City, 11 S. No. Carolina Ave.
PENNSYLVANIA, Philadelphia, 1621 Mt. Vernon St.
PENNSYLVANIA, Scranton, P. O. Box 237.
PENNSYLVANIA, Pittsburgh, 217 Water Street
NORTH CAROLINA, Asheville, P. O. Box 667
GEORGIA, NEWMAN, P. O. Box 246
FLORIDA, Lakeland, P. O. Box 371
LOUISIANA, New Orleans, Whitney Central Bldg.
KENTUCKY, Louisville, 111 North Third Street
OHIO, Cincinnati, 2651 Columbia Avenue
OHIO, Youngstown, 507 Stambaugh Bldg.
ILLINOIS, Aurora, 246 Cedar Street
MINNESOTA, Minneapolis, 917A Marquette Ave.
MISSOURI, Kansas City, 312 Elmhurst Bldg.
MISSOURI, St. Louis, Syndicate Trust Bldg.
NEBRASKA, Omaha, 504 First National Bank Bldg.
OKLAHOMA, Tulsa, 425 Iowa Bldg.
COLORADO, Denver, 932 Equitable Bldg.
CALIFORNIA, San Francisco, 115 Mission Street
CALIFORNIA, Los Angeles, 228 West 9 Street
CALIFORNIA, San Diego, 215 Timken Bldg.
WASHINGTON, Seattle, 2021 L. C. Smith Bldg.
WASHINGTON, Tacoma, 502 Provident Bldg.
WASHINGTON, Spokane, 616 Mohawk Bldg.
VIRGIN ISLANDS, St. Thomas, Main Street
CUBA, Havana, Victor G. Mendoza
CANADA, Montreal, H. P. Ross, 130 St. James Street
HOLLAND, The Hague, Buhaak & Co.
FRANCE, Bordeaux, 53 Rue Borie

Quality: It means more than price

The B Co INC

PULP

"Hafslund Bear"
"Forshaga"
Bleached Sulphite

"Klarafors"
Easy Bleaching Sulphite
Strong Unbleached Sulphite

"Hurum"
"Bamble"
Extra Strong Kraft; Bleached and Bleachable Sulphate

"Edsvalla" 50% Moist
"Dejefors" Dry
White Spruce Ground Wood

Tonnages available on dock for prompt shipment

THE BORREGAARD CO., INC.
200 FIFTH AVENUE NEW YORK CITY

TRADE MARK L X QUALITY SERVICE

LA BOITEAUX

Box Boards, Paper Board Specialties

Let your requirements be supplied by the leaders—you get the full advantage of our mill connections and control of production.

Low price—prompt service—intelligent understanding of your needs—all are yours to command.

Quotations at any time with samples.

The C. L. La Boiteaux Co.
Cincinnati Cleveland Chicago New York

STOWE & WOODWARD CO.

Newton Upper Falls, Mass.

Makers of Rubber Covered Rolls

Maximum Resiliency WITH Minimum Softness

Long Life

Canadian Mills Kept Busy by Newsprint Demand

With paper mills throughout the district of Montreal running more than 90 per cent capacity, it is believed the industry shows a return to conditions of normal prosperity. Reports coming from various quarters of the trade there and in the United States show that both wholesale and retail stocks are very much in need of being replenished. The demand from local markets as well as the United States is constantly increasing.

This is particularly true of newsprint in which department it is felt stabilty in price has been permanently attained. As a result of this increased consumption of newsprint, business during the months of last December, January and February was greater than ever before at that time.

The trade and commerce department at Ottawa recently showed Canadian exports of pulp to the United States for the ten months ended January 31, 1921, to have amounted to $21,542,000. The largest item was sulphate (kraft) placed at $6,287,736. Though this was a rather heavy decrease from the same period of the previous year, the tendency since late last fall has been constantly upward. The statistics covering shipments in February, March and April are expected to show quite a considerable increase both as compared with the same months in 1921 and with November, December and January just passed.

The Skowhegan Paper Company, a new corporation, has just been formed in Bangor, Maine, to take over the bankrupt Maine Pulp and Paper Company, whose property is located in Skowhegan. The stockholders of the new concern are creditors of the former corporation. James D. Rice representing the syndicate of creditors, purchased the property of the bankrupt firm at Buffalo, New York, last week from the trustee in bankruptcy. The capital stock of the new concern is $400,000 of which $200,000 is preferred and the remainder common. Officers have been elected as follows: Harold Stickney, of Bangor, president; James D. Rice, treasurer; Ballard Keith, clerk; directors, Harold Hinckley, Charles W. Mullen, James D. Rice, Ballard Keith and James P. Quine. The new company plans to resume operations in the near future. The property consists of a paper mill with an output of about 15 tons of newsprint, tissue, and fibre paper per day and a pulp mill of 30 tons ground wood per day capacity.

A new ground wood concern whose operations commenced on a satisfactory basis recently, is located at South Gardiner, Maine. It is known as the Pine Tree Pulp Company with L. H. Machette, president. It is expected that the mill will have a capacity of about 25 tons of ground wood daily, the pulpwood for which it is the present intention to bring up the Kennebec river, from the banks of which it will be cut. It is proposed to feed nothing but spruce pulpwood that has been hand barked to the grinders. George F. Drew, well known Maine mill engineer, did the engineering work and prepared the plans for the construction of the mill. Modern ideas were adopted so that the least possible amount of labor is necessary per ton of ground wood produced. A finely ground pulp is the aim of the owners.

The flood waters of the Connecticut and Merrimack Rivers and their tributaries and the rivers of Maine have done much damage to bordering paper mill property. The only case of any considerable loss however was at Cherryfield, Maine, where heavy rains caused such a swelling of the River that an old mill formerly operated by W. M. Nash & Sons, of New York, and now owned and operated by the Eastern Manufacturing Company has been breaking up and coming down the river.

The American Writing Paper Company startled the local trade when it inserted full page ads in Boston papers describing why it would be well for paper buyers to concentrate on their "master line of nine" bond papers. This sort of aggressive salesmanship is certainly reaping the results that usually come to a plugger. The fact that the American's 26 mills are running 80% of capacity speaks for itself. Many other fine paper mills can not show more than 50% of capacity operations.

The Robert W. Linton Co., Incorporated, has been chartered under Rhode Island laws. They state in papers of incorporation that they will manufacture paper, and it has been reported that paper board will be the product. The capital stock is 600 common shares of a par value of $100 each. Robert W. Linton of Pawtucket, Walter C. Newell and Henry L. Burdick are the incorporators.

Entire Satisfaction for 5 Years

D

DILL & COLLINS CO.
PAPER MAKERS
DELAWARE MILLS
RICHMOND & TIOGA STREETS
PHILADELPHIA

December 17, 1921

FOXBORO RECORDING INSTRUMENTS

Dear Sir:

We have six Foxboro Recording Pressure Gauges in use in our Digester Room at Delaware Mills. They have been in service for about 5 years and have given entire satisfaction.

They are used for recording the pressure on the digesters in cooking our soda pulp.

Yours very truly,

DILL & COLLINS COMPANY,
Gilbert N. Collins
Asst. Gen. Mgr.

GNC:KK

We make indicating and recording Liquid Level Gauges, Thermometers, Pressure Gauges, CO_2 Recorders, etc., for use on

Stuff Chests
White Water Tanks
Bleach Tanks
Digestors
Dryer Rolls
Drying Lofts
Size Tanks
Boiling Kettles
Acid Recovery Stills
Incinerators
Power Plants

Foxboro Gauges are thoroughly tested so that they will give you the same satisfactory service year after year as those used by Dill & Collins Company.

Let us tell you how the application of Foxboro Instruments to this and other paper mill processes will improve the efficiency and economy of your operation.

Write Dept. B. B.

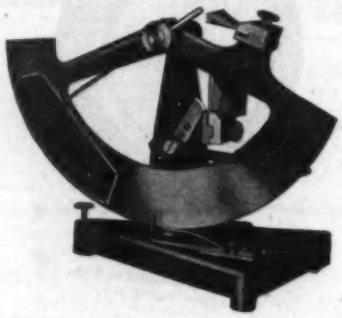
THE FOXBORO CO., Inc.
FOXBORO, MASS., U. S. A.
New York, Chicago, San Francisco, Tulsa, Pittsburgh, St. Louis, Philadelphia, Birmingham

FOXBORO
TRADE MARK

118-142

ELMENDORF PAPER TESTER

Determines Tearing Strength



This device is built for dependability and makes an accurate and rapid test of the tearing strength of paper. It enables the buyer of paper to issue standard specifications on a scientific basis.

Write for Bulletin 17 on Paper Testing Instruments

Thwing Instrument Co.

3353 Lancaster Avenue Philadelphia, Pa.

73

Manufacture of Pulp and Paper in Five Volumes

Being prepared by the Joint Committee on Vocational Education of the Pulp and Paper Industry.

Volumes I, II and III now issued.

Volumes IV and V are expected during the year.

The work is adapted to the classroom, to home study and for use as a reference work. Every firm and individual connected with the industry or interested in the pulp and paper business should own one of these sets.

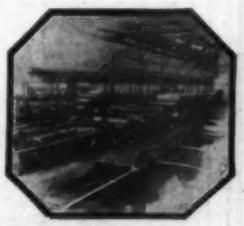
The volumes issued are on sale at $5.00 a volume and orders should be placed with the Technical Association of the Pulp and Paper Industry, 18 East 41st Street, New York, N. Y.

Where Saving Pennies Wastes Dollars

A Fourdrinier Machine represents a large investment—in many cases more than a hundred thousand dollars is invested in a single machine.

A small, but vitally important part of the investment is the Fourdrinier wire.

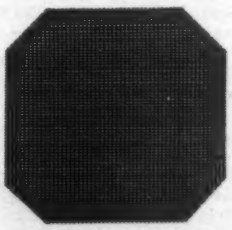
A Fourdrinier wire that has nothing to recommend it but the price—that wears out quickly and needs to be replaced frequently—cuts down the number of hours that the Fourdrinier machine is in operation and reduces the income on the investment.



The saving in applying a "price" wire is wiped out many fold by the loss in production and labor.

An expensive Fourdrinier machine to produce the maximum returns on the investment, should be equipped with a dependable Fourdrinier wire.

Tyler Fourdrinier wires are woven from special composition metal to assure long life; they run straight and true, and the careful weaving produces a better quality paper. Made in widths up to and including 250 inches.



The W. S. TYLER COMPANY, *Cleveland, O.*

Manufacturers of Foudrinier Wires, Cylinder Faces, Washer Wires, and Corduroy Cloth

Vocational Courses at Wisconsin Mills

The Consolidated Power & Paper Co. and the Nekoosa-Edwards Paper Co., in Wisconsin, have taken the lead in the movement for vocational education in paper mills which is developing all over the country. The Consolidated has been conducting courses in chemistry, electricity, and shop mechanics, and next year will co-operate with the local school in a course in paper making which is now in preparation. The Nekoosa-Edwards company has been conducting a regular course at the Port Edwards mill on the basis of text books prepared by the American Pulp & Paper Association.

The course in paper making which will be given in the local vocational school under the direction of W. A. Sprise is now in preparation. Officers of the Consolidated company have outlined a course which is believed to be an advance over anything in the line of vocational education in the paper industry that has been attempted heretofore.

At Port Edwards the course prepared by the Technical Association of the Pulp and Paper Industry for use in mills throughout the country is now being used.

According to a recent report of George E. Williamson, president of the Technical Association of the Pulp & Paper Industry, the work already under way here and at Port Edwards is rapidly being taken up by mills in other states, and it is expected that vocational education will soon be general throughout the paper industry.

Reorganization of Peshtigo Pulp & Paper Company and the Peshtigo Fiber Company was effected at a meeting of stockholders, who voted to sell their interest in the companies to the new corporation which is to be known as the Peshtigo Paper Company. The deal will be consummated within thirty days as a result of reorganization and $900,000 will be put into the new concern, of which $300,000 will be spent in improvements, it was said. John G. Sutherland of Dayton, O., will manage the new company.

A deal that has been pending for some time has been closed for the sale of the Menominee river water power known as the White Rapids to the White Rapids Paper Co. The property, which includes about 4,000 acres of land on the Michigan and Wisconsin sides of the river, was owned by Hooper & Hooper, of Oshkosh, Wis., the well known water power attorneys. It is understood that a large paper mill will be erected the coming season. It has been variously estimated that from 5,000 to 10,000 horse-power can be generated at the rapids.

The Sutherland Paper Co., Kalamazoo, Mich., recently displayed a complete line of cartons at an exhibition held in that city of things made in Kalamazoo and that helps to make Kalamazoo.

The Company specializes in cartons and has a capacity of 1,500,000 to 2,000,000 of the small pound size a day. The cartons are cut, printed, waxed, shaped and delivered finished in the company's plant. The board for the cartons is manufactured in the company's own mill.

It is said that contracts are to be let shortly for a large building on the west side of the city of Neenah, Wis., to house the Valley Paper mills plants. This is a newly organized concern which proposes to carry on the manufacture of glazed and special papers. The mill building planned will be one of the largest and best equipped in the valley.

A contract for the enlarging of the Morris Paper Mills, of Morris, Ill., has been awarded to the Hanson-Peterson Co., of Joliet. A new building, 150x300 feet, containing 45,000 square feet of floor space, will be erected to accommodate the increasing business of the mills. The mill has been operating at 100 per cent capacity.

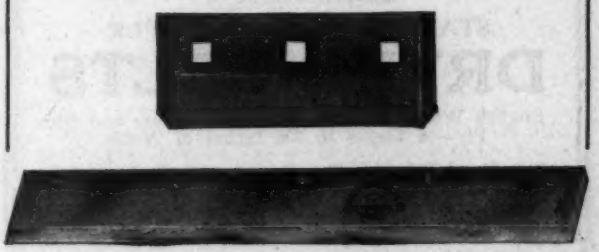
It is reported that the San Raphael Paper Co., Mexico City, will build a large mill at Merida, Yucatan, to manufacture paper from the leaves of the henequin plant. The output of the proposed mill will be used to supply the home demand, and whatever surplus there may be will find a market in Central American countries, it is expected.

It is reported that a change has taken place in the management of the Crown-Willamette Paper Co., of Oregon City, Ore. C. A. Morden, formerly manager of the mechanical department, with headquarters in Portland, takes charge of the West Linn mill, while A. Bankus, formerly manager both at Oregon City and Camas, becomes assistant to A. J. Lewthwaite, head of the Northwestern division of the company.

It is rumored that plans are being discussed for the establishment of a wood pulp mill at Aberdeen, Wash.

SIMONDS
MANUFACTURING COMPANY

Machine Knives
FOR
Paper and Pulp Mills



Highest Quality—Finest Steel—More Production

Write for Catalog and prices

SIMONDS MANUFACTURING CO.
Fitchburg, Mass. Chicago, Ill.

Established 1823
The
Smith & Winchester Mfg. Co.
SOUTH WINDHAM, CONN.

Manufacturers of

Paper Making Machinery

Paper Bag Making Machinery

The Undercut Trimmer

Die Cutting Presses

Overcut Cutters

Let Us Quote on Your Requirements

BROWN-WALES CO. SELAW IRON & STEEL

"Headquarters in New England" for **IRON AND STEEL and Kindred Materials**

Immediate Delivery
Distributor for Armco Iron

BROWN-WALES CO., Boston 9, Mass. 55 Church St., New Haven 261 Broadway, N. Y. C. Bangor, Maine

BARS — SHEETS — STRUCTURALS

Fitchburg Duck Mills

ESTABLISHED 1844
FITCHBURG, MASS.
MANUFACTURERS OF
STANDARD AND MULTIPLE
DRYER FELTS

English Weave in Two, Three, Four, Five and Six Ply—60 Inches to 176 Inches in Width

Fine Faced Felts for Fine Papers. Absolutely no felt marks in paper. TRIBUNE Three Ply Felts for Coarse Papers.

Hamilton Top Felts

run until worn out, with less trouble of "picking" on machine than any other make of top felts can show. A trial is invited

SHULER & BENNINGHOFEN
HAMILTON, OHIO

Advantages of Hercules Wood Rosin

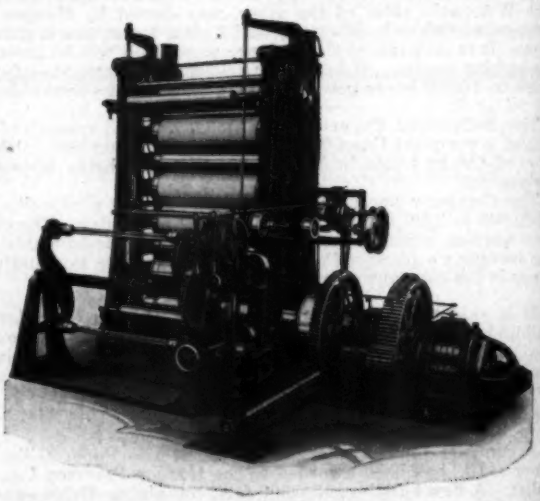
Paper manufacturers who rely on Hercules Wood Rosin are assured of a dependable supply that is free from foreign material, and is uniform in color and quality. More than this, they are offered the co-operation of a large and well equipped chemical organization with an interest in Hercules products that does not stop when a sale is made.

If you wish to eliminate the variations between different lots of rosin that cause trouble and expense, write to our Naval Stores Division. It may be that our technical staff, working with yours, can save you money in more ways than one.

Naval Stores Division
HERCULES POWDER CO
Wilmington Delaware
Sales Offices { 120 Broadway, New York; 332 So. Michigan Ave., Chicago; 1013 Chronicle Bldg., San Francisco

HERCULES Naval Stores
Produced Under Chemical Control

NORWOOD SUPER CALENDERS



WE ARE SPECIALISTS IN
Paper Finishing Machinery

NORWOOD ENGINEERING CO.
FLORENCE, MASS., U. S. A.

WANTED:

First class Beaterman for beating and coloring stock for cylinder machine making specialties. Give references and previous employment.

DISTRICT OF COLUMBIA PAPER MFG. CO.
WASHINGTON, D. C.

"NORTHERN" Cranes and Hoists
Northern Engineering Works Detroit, Michigan

Dedicates Community House

The Kalamazoo Vegetable Parchment Co., Kalamazoo, Mich., believe in doing things for their employees to make them contented, harmonious and efficient citizens of the community. The company has just built what is known as the Parchment Community House, designed and constructed by Billingham and Cobb, architects. The house was dedicated with impressive ceremonies on Saturday and Sunday, April 8 and 9.

The thing which prompted the building of this community house is set forth on the back page of the program, and is the big thought that "men, not things, after all make up the importance of life." The house has become dedicated to the betterment of humanity, and to this end the co-operation of the entire community is invited.

On April 18, ten loyal employees of the company, who had completed ten years' service with that concern were guests of honor at a supper and entertainment given at the community house. Each received a substantial bonus check as recognition of faithful service rendered over a long period.

The Valley Paper Company, of Holyoke, which recently completed the installation of a new machine, is receiving a favorable report on the saleability of the new sheet. A company which brings into operation a new paper machine in these times of business reconstruction and then makes a success with the product is worthy of the highest praise for the quality of the paper made.

Serious accidents in New England paper mills this month include three men injured in the fall of a staging at the Brown & Company sulphite mill at Berlin, New Hampshire, and concussion of the brain suffered by a worker at the Livermore Falls mill of the International Paper Co.

At the recent meeting of the International Paper Co., the following were elected directors for three years: Philip T. Dodge, Albert H. Wiggin, Ogden Mills and Herbert A. Wilder. W. D. Russell declined re-election and Malcolm Chase was chosen in his place.

The new mill of the International Paper Co., has started operating at Three Rivers, Quebec, the first machine producing sixty tons of newsprint daily. Three more machines will be added, it is said.

A sad accident occurred at the mill of Oxford Paper Company when a young employee was instantly crushed to death in a paper machine last month. Educational methods are reducing such accidents to the minimum.

The United Paper Board Co., Peoria, Ill., is now at work with a full complement of men for the first time since fire gutted the concern, 17 months ago.

The Fort Orange Paper Company, of Castleton, N. Y., has increased its capital from $200,000 to $500,000.

Ten Accomplishments of A. P. P. A. in 1921

Ten accomplishments of the year 1921 were cited by Dr. Hugh P. Baker, Executive Secretary of the American Paper and Pulp Association, when he addressed a conference of members of the Association from the Black River District and invited guests at the Black River Club recently. The conference was held to determine what practical assistance could be rendered the manufacturers of that region by the central organization and to get this work started before Dr. Baker goes abroad this summer to investigate for the American paper industry the status of the paper industry in Europe, particularly in Scandinavia:

"Through the central organization it has been possible to achieve some important results during the last year," said Dr. Baker, "results which could not have been accomplished by the manufacturers working individually. The ten which are probably of greatest importance to the entire industry are the following:

"Made presentation for the paper industry of tariff brief which won very favorable comment from the Senate Finance Committee.

"Through strong committee from the industry influenced the establishment of a Paper Division in the Department of Commerce.

Used in More Than 9,000 Plants

Better join up with this satisfied army of friends who know what a profitable move it is to eliminate poor combustion conditions, escaping heat and needless repairs with a permanent, modern setting of

"STEEL MIXTURE"

Settings of "Steel Mixture" reduce the joints more than two-thirds. Because they are smooth and with few joints they last more than twice the life of ordinary fire brick. These tested facts are worth considering.

Write us at once for "Book of Measurements" and information about Boiler Door Arches, Fire Box Lining Blocks, Back Combustion Chamber Arches, Blow-Off Pipe Protectors, Ignition Arches or Dutch Ovens. We ship from stock immediately; settings fitted to your exact requirements.

McLeod & Henry Co., Troy, N. Y.

New York Boston Detroit

POWELL

DOUBLE EXTRA HEAVY

VALVES

REGRINDING HYDRAULIC VALVES

Globe, Angle, Cross Gate or Check Patterns for controlling at

HIGH PRESSURE

Steam, Water, Oil, Air, Gas or Chemical Solutions

Unequalled for Severe Service

The Wm. Powell Company

CINCINNATI, OHIO

THE WATERBURY FELT CO.

SKANEATELES FALLS

New York

FELTS and JACKETS

Top and Bottom Wet Felts for board machines, with all the qualities requisite to insure long life and continuous production.

They Satisfy

Get This FREE BOOK

It contains valuable information on air washing and conditioning, including temperature and humidity tables and examples of efficient air conditioning installations.

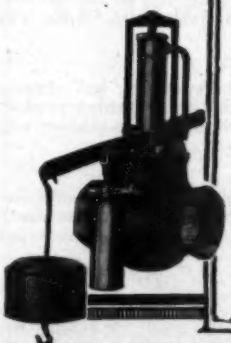
The Bayley Automatic Washer

removes impurities from air used for ventilating and heating purposes. A complete conditioning unit increases or decreases the relative humidity of the air and keeps its temperature practically uniform throughout the year.

THE FREE BOOK EXPLAINS HOW THIS IS ACCOMPLISHED. SEND FOR YOUR COPY TODAY.

Bayley Mfg. Co.
Dept. B
MILWAUKEE, WIS.

A Better Regulator at a Lowered Price



THE Davis is the best pressure regulator for paper mills. It requires less attention, lasts longer, and gives steadier, more accurate pressure reduction. No springs—no diaphragms—no toggles—no packing; just a finely balanced inner valve.
You can get Davis Regulators at the lowered prices listed below—money back if not satisfied. Write the G. M. Davis Regulator Co., 414 Milwaukee Ave., Chicago.

Size, Inches	Price
¾	$22.50
1	25.00
1¼	27.50
1½	30.00
2	35.00
2½	42.50
3	50.00
4	70.00

DAVIS VALVE SPECIALTIES

STEAM SAVERS SINCE 1875

SWENSON EVAPORATOR CO.

Main Office
945 Monadnock Block, Chicago

Eastern Offices
519 Widener Bldg., Philadelphia
30 Church St., New York

Works
Angola, Indiana Harvey, Illinois
Bedford, Indiana Joliet, Illinois

Cable Address, "Evaporator Chicago," Western Union Code

EVAPORATORS

"Established Information Service as clearing house for statistical and informational material for use within and without the industry.

"Developed Woodlands Section for pulpwood statistics and direct service to those responsible for the woods operations of the paper industry.

"Aided in preventing passage by Congress of hastily drawn bills on stream pollution which would have closed many paper mills, and joined Secretary Hoover in asking investigation to determine proper legislation.

"United important industrial and social organizations in campaign for national forestry legislation.

"Stimulated governmental and mill studies of wood and pulp decay prevention.

"Established co-operation through a standing committee of the Association with the U. S. Bureau of Standards.

"Accomplished closer co-ordination of the Technical, Cost, Salesmen's and Superintendents' Association, extending their service to all members of the Association.

"Conventions in New York and Chicago, co-ordinating more closely than ever before all elements of the industry."

News Personals

Percy Wells, for several years sales representative in the New England territory for the Tileston & Hollingsworth Company, of Boston, has resigned and opened offices in the John Hancock Building in Boston from which he will conduct business as a paper mill agent.

At the annual meeting of the International Paper Company in Corinth, N. Y., on April 26, Malcolm G. Chance was selected to the Board of Directors to succeed E. W. Russell, a vice president of the company, who declined re-election. Philip T. Dodge, Albert H. Wiggin, Ogden Mills and Herbert A. Wilder were re-elected directors for three years. After discussion of the labor troubles which the company has encountered in the last year, a resolution was adopted endorsing the course followed by the officials of the company. President Dodge said after the meeting: "The International Paper Company will continue to work on the American plan. We shall not deal with outsiders on questions connected with the labor we employ, but we shall always discuss wages and working conditions with our employes either singly or in groups, and shall co-operate with them to the fullest extent in order to improve their conditions." The annual financial statement showed a surplus of $23,456,220 on December 1, 1921.

The Urquhart Paper Company, Inc., recently organized has started in business with offices and warehouse located at 58-60 Reade street, New York City. C. K. Urquhart, president of the new firm, formerly was for many years with the paper jobbing firm of F. A. Flinn, Inc., of New York. Edward A. Golden, also heretofore with the Flinn organization, is associated with Mr. Urquhart as secretary and treasurer of the new concern.

Frank W. Clark, president of the Gulf Pulp and Paper Company, of Clark City, Quebec, returned via New York on the steamer Homeric from a trip to Europe on April 13. Mr. Clark traveled through the Scandinavian countries and England and stated that he found the pulp and paper industries on the other side in a fairly healthy condition.

W. Ward Smith, of Spring Valley, Long Island, who had been secretary to Governor Miller of New York since the latter took office a year ago last January, resigned his State office last month to become general manager of the American-Canadian Lumber and Pulp Company, with offices in New York City.

Colonel Benjamin A. Franklin, vice-president of the Strathmore Paper Co., has been appointed director of the Citizens Training Camp which will be conducted at Camp Devens, Mass., during the month of August.

Joseph Krockenburg, superintendent of the Deferite mill of the St. Regis Co., has resigned his position to become effective as soon as his successor has been appointed, but not later than July 1.

Arthur Pratt, president of the Allied Paper Mills, Kalamazoo, Mich., has started on a vacation trip in Europe, accompanied by Mrs. Pratt.

UNION SCREEN PLATE CO.
Fitchburg, Mass., U. S. A. Lennoxville, P. Q., Canada

[redacted]

UNION BRONZE SCREEN PLATES
(Best phosphorized Cast Metal)

Old Plates RECLOSED and RECUT to accurate gauge
UNION BRONZE SCREWS for Screen Plates
Immediate Delivery of the Largest Orders. Satisfaction Guaranteed

The Witham Screen Plate Fastener, Patented
THE ORIGINAL THE BEST

SCREEN PLATES *and* DANDY ROLLS

Watermarking a Specialty

Central Manufacturing Co.
The Quick Service House
KALAMAZOO MICHIGAN

Remember
WM. A. HARDY & SONS
FITCHBURG, MASS.
Originators and Oldest Manufacturers
OF THE
Cast Bronze Screen Plate
ALSO SPECIALIZE IN
Acid Resisting Digester Parts

Ticonderoga Machine Works
TICONDEROGA, N. Y., U. S. A.
MANUFACTURERS OF
WARREN IMPROVED CALENDER DOCTORS
With Flexible Blades, Universal Adjustment and Control
(PATENTED)
WARREN IMPROVED PATENT DOUBLE DRUM WINDERS
Patent BALL VALVE Hydrant
Stock Circulating Systems *and*
other Paper Mill Specialties
SEND FOR OUR BULLETIN

KALAMAZOO TANKS

Any Size or Shape

Blow Pits
Acid Storage Tanks
Vats, Etc.

We are especially well equipped to handle large tanks, having a good many years' experience in paper mill requirements.

Ask for catalog. Send us size required and specifications. We will make blue prints for same if desired.

KALAMAZOO TANK & SILO CO.
KALAMAZOO, MICHIGAN

STACKS BREECHINGS TANKS

Our erecting facilities are such as to make it possible for us to replace or repair smoke stacks in any part of the United States.

LITTLEFORD Steel Smoke Stacks and Flues are ENGINEERED to suit the individual requirements of every purchaser. The design and methods employed in their erection are the results of over thirty years' experience.

Our engineering ability and experience is at your disposal for the asking.

LITTLEFORD BROS.
500 E. Pearl St., Cincinnati, O.

WOODEN TANKS

Built to Order

Special study has been given to the requirements of the paper and pulp mills. Tanks for any purpose can be supplied and prices quoted on receipt of specifications or drawings.

Our Slogan—"Satisfied Customers Only"

Write today for information that should be in your possession. This is a part of our Co-operative Service.

Pittsburgh Office
406 BAKEWELL BLDG.
Houston (Texas) Office
329 BEATTY BLDG.

SHARP KNIVES

Mean

GREATER PRODUCTION
LESS COST **BETTER WORK**

Sharp, true, keen-cutting edges are the results of Knives sharpened on this machine.

This cut shows our Type "G" Grinder with Full Automatic Feed and Water Attachment

These essential features are clearly shown in this cut. Our Type "G" is "THE" Machine for the Paper Mill, as it will very readily grind Hog, Barker, Chipper and Paper Cutting Knives up to its capacity.

Type G in sizes from 26" to 72"
Type B in sizes from 54" to 130"

Guaranteed to eliminate your Knife troubles

Write for Our Catalogue

SAMUEL C. ROGERS & CO.
No. 22 Lock St., Buffalo, N. Y.

"World's Pioneer Knife Grinder Builders"

R. F. Knott

R. F. Knott, president of the Crescent Paper Co., Marseilles, Ill., died on Tuesday, May 2, 1922, in the Illinois Valley Hospital, So. Ottawa, Ill. He returned two weeks before from a visit to Chicago, where his wife was in a hospital. He was not feeling well and two days later underwent an operation for appendicitis. After several days hovering between life and death, he passed away.

Mr. Knott was born in Mobile, Ala., 59 years ago last January. He was a typical southern gentleman, but very democratic in his mode of life. He came to Marseilles in 1892 where he entered the employ of the Marseilles Land and Water Power Co., of which he later became manager. The Marseilles Strawboard Co. was founded by Mr. Knott in 1896 which later branched out and included a printing plant and paper box factory. This plant was entirely destroyed by a fire, but through Mr. Knott's undaunted courage the plant was rebuilt on a larger scale and became known as the Crescent Paper Co. Mr. Knott secured the contract for supplying strawboard to the Quaker Oats Co., and every year saw an enlargement to his mills until today the plant is reported to be valued at $1,000,000.

He is survived by his widow and one son, Richard, aged 26. He also leaves two unmarried sisters, Misses Lizzie and Willie Knott, and one unmarried brother, John P. Knott, all of Mobile, Ala.

Mr. Knott resided in East Ottawa, Ill., and funeral services were held under the auspices of Knights Templar in Christ Episcopal Church, from where the remains were shipped to Mobile, Ala., for burial.

E. A. Newton

Mr. E. A. Newton, who for the past five or six years had been treasurer and general manager of the Glatfelter Pulp Wood Company, with offices at 603 American Building, Baltimore, died very suddenly of typhoid fever on April 17 in Johns Hopkins hospital. Mr. Newton was about thirty-five years old, and is survived by his wife and two children.

The Glatfelter Pulp Wood Company supplies the pulp wood for the mills of P. H. Glatfelter Company, Spring Grove, Pa.

Frank E. Dunaway, widely known among paper manufacturers as a wood pulp salesman and for the last several years in business for himself at 501 Fifth avenue, New York, is now associated with the wood pulp department of the Perkins-Goodwin Company, 33 West Forty-second street, New York.

It has been announced that a contract has been awarded to Dwight P. Robinson & Co., New York, for the construction of a building to accommodate American commercial exhibits at the Brazilian Centennial Exposition to be held in Rio de Janeiro beginning September 7.

Dr. Baker to Visit Europe

Dr. Hugh P. Baker, executive secretary of the American Paper and Pulp Association, will spend eight weeks in Europe this summer, studying the paper industry particularly in Scandinavia, with reference to its bearing on the future of the industry in America.

In addition he will bear a special commission from the Department of Commerce for the making of a special study of the effect on the paper industry here and abroad of the establishment of new republics in Europe, and the revision of boundaries of old nations, as a result of the war.

Arrangements for this trip were proposed at a meeting of several leaders in the industry at a luncheon given by President Raybold of the Association, and developments since the trip was authorized have been so far completed that it is now certain that Dr. Baker will sail for Scandinavia on June 10.

Particular attention will be paid to the condition of the paper industry in Finland and Czecho-Slovakia, and Dr. Baker's trip will take him as well to Sweden, Norway and Germany, with shorter stays in other countries of Europe, his return being from a southern European port.

The American Paper and Pulp Association wishes to have Dr. Baker investigate particularly the conditions in Norway, Sweden and Germany, while the Department of Commerce is particularly anxious to learn what changes will result in Czecho-Slovakia and Austria, as well as Poland, as the result of the revision of European national boundaries.

The fact that Dr. Baker's doctorate degree was taken in a German university where he spent two years, will greatly facilitate his study of business conditions in foreign lands, as German is a common language for international conversations in northern Europe.

FOR IMMEDIATE SALE

Pulp Mill Equipment

3 Digesters, soft steel plate, welded joints, inside dimensions 8′ dia. x 27′ overall, test pressure 165 lbs., capacity, 1500 cu. ft. cradles, columns, false bottoms and heads included.
3 Morterud Liquor Heaters 44″ dia. x 11′ 6″ high.
3 Centrifugal Pumps, 5″ suction and discharge for liquor heater.
1 Centrifugal Pump, 3″ suction and discharge.
2 Tanks, Liquor Measuring, steel ¼″ plate sides, ⅜″ bottom, inside dimensions 10′ dia. x 12′ high.
2 Tanks, Liquor Heating, steel ¼″ plate sides, ⅜″ bottom, inside dimensions 10′ dia. x 12′ high, coils of 3″ extra heavy steel pipe, 12 windings, 8′ dia. x 8″ pitch.
1 Pump, centrifugal, horizontal, vertical discharge, 5″ suction, 4″ discharge for pumping liquor from heating tanks to digesters.
1 Pump, centrifugal, horizontal, vertical discharge, for pumping black liquor, 4″ suction, 3″ discharge.
1 Cyclone Separator Tank, ⅜″ plate, 12′ dia. x 9′ high.
1 Condenser, ¼″ plate, 6 ft. dia. x 14′ high.
1 Tank for hot wash water, 3″ wood, 12′ dia. x. 12′ high inside.
7 Diffusers, 5/16″ plate sides, top and bottom of ½″ plate, 10′ dia. x 16′ high inside.

Write, Wire, Telephone

Sales Department

CHARLESTON INDUSTRIAL CORPORATION

Nitro, W. Va.

FOR SALE CHEAP

Pumps

4 vertical, horizontal discharge, 3″ discharge, 3″ suction, 200 G. P. M. of sulphuric against a head of 30 ft. at 1150 R. P. M. belt driven, Pulley 10″ dia. 4½″ face. One bottom and one side inlet. Cast iron impeller and cast iron shaft connected to a steel shaft 1 7/16″ dia. Norman Hubbard Sons.

10 vertical, special submerged, cast iron horizontal discharge 3″, 3″ suction, belt driven with 12″ dia. 5″ face cast iron pulley. Kurtztown Foundry & Machine Company.

25 Class "C," open impeller type, 5″ suction, 4″ vertical discharge, 700 G. P. M., 50 ft. head, 1025 R. P. M., belt driven 8″ x 8″ pulley. Worthington Pump & Machine Company.

15 horizontal, vertical discharge 4″, 5″ suction, belt driven, 10″ x 8″ pulley. Lawrence P. & E. Co.

10 four stage horizontal type, manufacturer's No. 6, 8″ suction, 6″ discharge, horizontal, 1000 G. P. M., 635′ head, 1750 R. P. M., water cooled bearings. Mounted on base plates arranged for direct connection to motor or turbine. Allis Chalmers Mfg. Co.

12 single stage type EE, iron impeller, 8″ suction, 6″ vertical discharge, 1100 G. P. M., 85′ head, 950 R. P. M., belt driven, 10″ x 10″ pulley. American Well Works.

Write, Wire, Telephone

Sales Department

CHARLESTON INDUSTRIAL CORPORATION

Nitro, W. Va.

V. D. SIMONS
Industrial Engineer

PULP AND PAPER MILLS, HYDRO-ELECTRIC
AND STEAM POWER PLANTS
ELECTRIFICATION PAPER MILL PROPERTIES

39 S. LA SALLE ST.
CHICAGO

FERGUSON ENGINEERS
JOHN F. FERGUSON

Complete Pulp & Paper Mills, Investigation of New Enterprises, Special Heat & Power Applications, Hydro-Electric Developments, Steam-Electric Power Systems, Sectionalized Paper Machine Drives.
Analysis, Design, Construction, Operation Efficiency
Holyoke, Mass. 1210 First National Bank Bldg. CHICAGO, ILL.

James L. Carey
Paper Mill Architect and Engineer
208 N. Laramie Ave., Chicago, Ill.

HARDY S. FERGUSON
CONSULTING ENGINEER
200 FIFTH AVENUE **NEW YORK CITY**

Member Am. Soc. C. E.
Member Am. Soc. M. E.
Member Eng. Inst. Can.

PAPER, PULP AND FIBRE MILLS INCLUDING BUILDINGS AND COMPLETE MECHANICAL EQUIPMENT
WATER POWER DEVELOPMENT
DAMS, STORAGE RESERVOIRS AND OTHER HYDRAULIC STRUCTURES
STEAM PLANTS

Examinations
Reports
Estimates of Cost
Designs
Specifications
Valuations

J.H. WALLACE & COMPANY.
TEMPLE COURT BUILDING NEW YORK CITY, U.S.A. CABLES, TRIPLEX, N.Y.

PULP PAPER AND POWER PLANTS

ENGINEERS & CHEMISTS
INDUSTRIAL DESIGN PLANT IMPROVEMENT LABORATORY TESTS

L. A. DeGUERE
Industrial Engineer
Wisconsin Rapids, Wisconsin
Paper, Chemical and Ground Wood Mills, Hydro Electric and Steam Power Plants, Surveys, Estimates, Appraisals and Reports.

J. O. ROSS ENGINEERING CORPORATION
CHICAGO 30 E. 42d St. NEW YORK CITY BOSTON

PAPER DRYING SYSTEMS
HEATING VENTILATING
"STURTEVANT"
VAPOR ABSORPTION SYSTEMS

B. M. BAXTER
Consulting Engineer
5716 Euclid Avenue, Cleveland, Ohio
Engineering Service for Paper Mills
Construction and Production
BOOK, BOXBOARD, BONDS AND LEDGERS,
TISSUE, ROPE MANILAS AND SPECIALTIES

GEORGE F. HARDY
M. AM. SOC. C. E.
M. AM. SOC. M. E.
M. ENG. INST. CAN.

Mill Architect and Consulting Engineer
Langdon Building
309 Broadway, New York

SPECIALTY:
Paper, Pulp and Fibre Mills
Water Power Development
Steam Power Plants
Plans and Specifications
Valuations, Reports
Consultation

Cable Address:
"Hardistock"
A. B. C. 5th Edition
Bedford McNeill
Western Union
Bentley's

Stebbins Engineering & Mfg. Co.
Mill Architects. Watertown, New York

CHEMICAL PULP MILL EQUIPMENT
Specialty
ACID SYSTEMS, DIGESTER AND ACID PROOF LININGS, GUARANTEED

Service Department Always Ready for Emergencies. Only High Class Experienced Men Employed

Theodore W. Dunn Makes Change

Theo. W. Dunn, vice-president and general superintendent of the Detroit Sulphite Pulp & Paper Company, Detroit, Mich., has severed his connection with this company and will become engaged in the manufacture of sulphite papers in a plant which he is now starting.

Mr. Dunn started in the paper business in 1888. At that time his father, George F. Dunn, was superintendent of the Detroit Sulphite Fiber Company, which at that time made only Mitscherlich sulphite pulp, but in 1893 a paper machine was installed. At the time of George F. Dunn's death in 1902 the mill had three cylinder and one Fourdrinier machines. At the time of his father's death Theo. W. Dunn was given the position of general superintendent. A year later the plant was completely destroyed by fire. After rebuilding two additional machines were installed, giving the plant a pulp mill and a five-machine paper mill.

For the past eight years Mr. Dunn has also held the position of vice-president and was one of the directors. He now leaves the company after a continuous service of thirty-four years.

Laurentide Installs Electric Steam Generator

The Electric Furnace Construction Co., Philadelphia, advise that the Electric Steam Generator of the "Kaelin System" recently installed at the Laurentide Paper Co., commenced operating April 21. Although only designed for 25,000 kilowatts, this boiler is averaging 34,000 kilowatts and is producing 100,000 lbs. of steam per hour at 125 lb. pressure.

This is the largest Electric Steam Boiler ever built and it was put into operation without the slightest hitch. The space occupied by this Boiler is very small compared with the existing fuel fired boilers that it is replacing. The saving in coal alone amounts to 150 tons per day.

The Boiler was constructed and installed by the Dominion Engineering Works, Montreal.

Sixteen well known makers of fine papers combine in forming what is known as the Paper Makers' Advertising Club, which has headquarters at 142 Berkely street, Boston. Quarterly throughout each year they publish a beautifully arranged sample book showing excellent printing effects on their papers. They include a few well written articles on printing and the printers' problems. This direct work of the paper mills has been found of immense value. The mills in the Club are Advertisers' Paper Mills, Beckett Paper Co., Chemical Paper Mfg. Co., Crane & Co., Crocker-McElwain Co., Dill & Collins Co., Eastern Mfg. Co., Gilbert Paper Co., Hammermill Paper Co., Hampshire Paper Co., Knowlton Bros., Millers Falls Paper Co., Neenah Paper Co., Strathmore Paper Co., Tileston Hollingsworth Co. and Geo. W. Wheelwright Co.

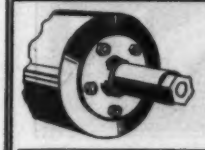
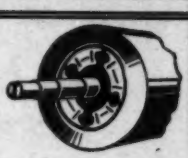
Sandvik Steel, Inc., New York City, has issued a twenty-eight page catalogue giving complete information as to how steel belt is applied to solving conveying problems; its efficiency, economy, etc. Although very little material is in print on steel conveyor belting, the Sandvik Steel Works have been producing them for the past twelve years, and have made 1300 installations of conveyors of varying dimensions up to 800 ft. center distances in the many phases of the manufacturing world. A limited supply of this catalogue is available.

The Advantages of Engineering to the Pulp and Paper Industry is the name of a booklet which has recently been issued by the Management Engineering and Development Co., Dayton, O. The part the engineer may play in creating the successful mill is covered in an outline of the scope of the work of this company, and can be summed up in three words: Design, Construction and Operation. If anyone is interested and would like to see a copy of this booklet, he can obtain one by writing to the company.

The United States Civil Service Commission announce an open competitive examinaton for Federal civil service to take place on June 7 and 8, and July 19 and 20, 1922. The titles of the examinations are Laboratory Assistant, Senior Grade; Laboratory Assistant, Junior Grade and Assistant Aeronautical Engineer. Application blanks may be obtained from the local secretary of the United States Civil Service Board at the post office.

Judge A. N. Hand on April 26 appointed Percival Wilds receiver for the Caine Brothers Paper Company, Inc., paper dealers of 29 West Houston street, New York City.

RUSS GELATIN CO.
Factory—WESTFIELD, MASS.
MANUFACTURERS OF
GELATIN and GLUE
ANIMAL SIZING GLUE STOCK
LARGEST SPECIALISTS IN AMERICA ON
FINE WRITING PAPER SIZING
E. F. RUSS COMPANY 201 Devonshire S. BOSTON, U. S. A


SERVICE
Wood Rolls

A Construction for Every Service

Free Blank Roll Blue Prints sent on request to any Paper Mill

Rodney Hunt Machine Co., 45 Maple St., Orange, Mass.

Standard Ultramarine Blues
For the Paper Industry
ASK FOR SAMPLE OF
NEOS R BLUE
The Highly Alum-Resisting Ultramarine
AGENTS
E. M. & F. WALDO, 10 High Street, Boston, Mass.
THE WESTERN PAPER MAKERS CHEMICAL COMPANY
Kalamazoo, Mich.
Manufactured by
THE STANDARD ULTRAMARINE CO.
Huntington, West Virginia

CASEIN
Standard Quality
Lowest Prices
The Casein Manufacturing Company
15 Park Row New York

A Lucky Guy

Uncle Billy Richards will tell you he had a close call and that loose sleeves around moving machinery are dangerous

36 New Safety Bulletins Each Month

Will Make Your Shop Bulletin Board As Interesting As a Newspaper

All posters attractively printed in two colors. Sizes 9"x12" and 17"x23".

Members of the National Safety Council receive 36 different safety posters each month —extra copies as desired. A new bulletin every day!

OUR SAFETY BULLETINS attract the workers' attention, and hold their interest. No highbrow stuff—they don't shoot over the heads of the workmen! Simple, yet full of human interest, they put the safety message across in a way that sticks! Results? They have helped many of the Council's members to reduce accidents 75 per cent or more because they instruct, they stimulate safety thinking, and they develop the safety habit among the men.

SAFETY BULLETINS comprise only one item of the service you will secure through membership in the National Safety Council—a non-profit, co-operative association of 3,500 employers helping each other to reduce the cost of accidents to their workers.

Write for sample safety bulletins today—post them on your bulletin boards and watch the results.

NATIONAL SAFETY COUNCIL

Co-operative Dept. P-1 Not-for-profit

168 North Michigan Avenue Chicago

Society of American Foresters Re-elects O. M. Porter

O. M. Porter, secretary of the Woodlands Section, and assistant secretary of the American Paper and Pulp Association, was unanimously re-elected secretary of the New York Section, Society of American Foresters, in the recent annual meeting at Syracuse, N. Y. He had been anxious to drop the duties of the foresters organization, but the state foresters refused to allow him to retire, doubtless due to the fact that the paper industry is a leading factor in the forestry problem of New York State. Many of the foresters in attendance were men who are officially connected with the paper industry. Prof. R. S. Hosmer, head of the Forestry Department of the State College of Agriculture at Cornell University was re-elected president of the section. Among the subjects discussed were notably the so-called minimum requirements for protection of the forest during lumbering operations, in order to promote the growth of a new crop of timber. The paper industry is doing active work along reforestation lines in New York State, as well as elsewhere in the northeastern states, and George W. Sisson, Jr., former president of the American Paper and Pulp Association, is chairman of the Association's forestry committee which formulated a national plan of legislation to promote reforestation. Mr. Sisson was such a believer in the practical side of forestry that his son was educated at Cornell, taking the forestry course, in order that he might be able to handle scientifically the pulp wood lands of the Racquette River Paper Company, a Sisson interest.

The Dodge Sales and Engineering Company, Mishawaka, Ind., manufacturers of power transmission appliances and heavy oil engines, announce the removal of their New York City branch from 21 Murray street to the new Dodge building, located at the corner of Park place, W. Broadway and Murray streets, and known as 53 Park place.

The Uehling Instrument Co., Paterson, N. J., has issued a new Bulletin 112, covering Uehling CO, Recording Equipment, for guiding the engineer and fireman in reducing the waste of fuel up the chimney.

The Rudolph Paper Company, paper merchants of New York City, has filed notice of an increase in capital stock from $100,000 to $500,000.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

Of The Paper Industry, published monthly at Chicago, Illinois, for April, 1922.

State of Illinois, County of Cook—ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Edward B. Fritz, who, having been duly sworn according to law, deposes and says that he is the Publisher of The Paper Industry, and that the following, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Edward B. Fritz, Chicago, Illinois; Editor, A. Scott Dowd, Chicago, Illinois; Managing Editor, none; Business Managers, none.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent or more of the total amount of stock.) Edward B. Fritz, Chicago, Illinois.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is .... (This information is required from daily publications only.)

EDWARD B. FRITZ,
(Signature of Publisher, business manager, or owner.)

Sworn to and subscribed before me this twenty-third day of March, 1922.

(SEAL.)

MARY F. ALLEN.
(My commission expires March 20th, 1926.)

The Seymour Company, paper merchants of 245 Seventh avenue, New York City, has purchased the property at 323-327 West Sixteenth street, which, after improvements have been made, it will occupy later in the year. The building has a frontage of 75 feet and a floor capacity of about 26,000 square feet.

The executive and sales offices of the Kalbfleisch Corporation, papermaking chemical manufacturers and dealers, have been moved to the Fifth Avenue Building in New York City after having been located for the past 17 years at 31 Union Square West, New York.

The Great Notch Paper Company, Inc., hitherto located at 41 Park Row, New York City, is now comfortably settled in its new office and warehouse at 101-103 Varick street, New York, where a full stock of paper in which it deals is carried.

Making Economy Records
"SHURFLO"
Wick *Feed*
OIL CUPS

Save in oil, save in repairs, save in horse power and fuel, all of which means savings in operating costs.

Made from half to ten ounce capacity. Oilers sent on a 60 days' free trial. Booklet free.

HUNTER PRESSED STEEL COMPANY
600 Pierce Street Lansdale, Pennsylvania

Claflin Continuous Beaters

Will take the pulp from the digestors and deliver it to the Paper Machine without the use of tub-beaters or Jordan engines.

You can cut down expenses by writing

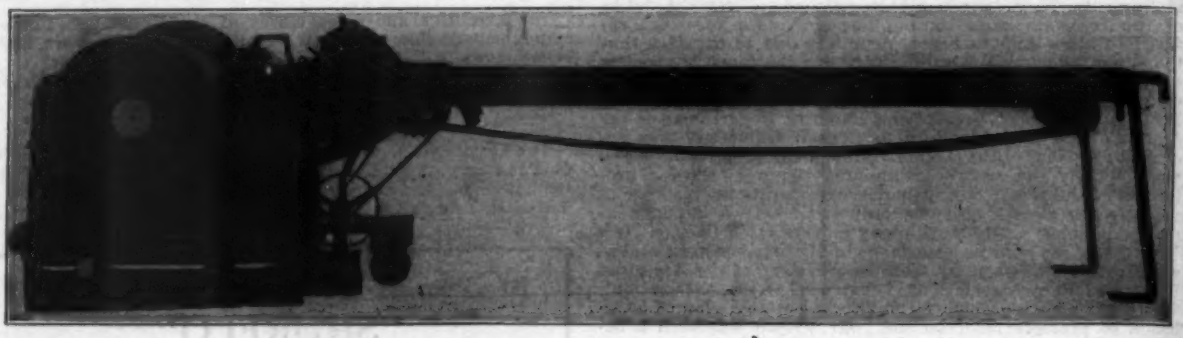
THE CLAFLIN ENGINEERING COMPANY
LANCASTER, OHIO

The Pulp and Paper Trading Co.
21 East 40th Street New York City
Dealers in Domestic Chemical and Mechanical Pulps and Paper

AGENTS FOR
J. & J. Rogers Company, Au Sable Forks, N. Y.
Canadian Kraft, Ltd.
Dealers in Wayagamack Kraft
Three Rivers, Canada
Ware Coated Paper Company, Ware, Mass.

EASTERN AGENTS FOR
Port Huron, Michigan, Sulphite
Made by Port Huron Sulphite & Paper Co., Port Huron, Mich.

No. 11 "GIANT" PAPER STOCK CUTTER



Capacity 2½ Tons Per Hour
Especially Adapted for Handling Waste Paper, Magazines, Etc., Before Feeding to the Beaters

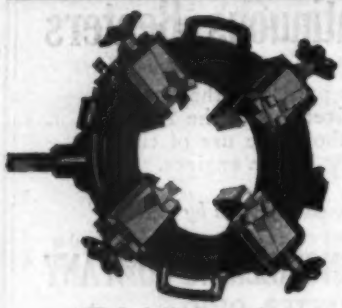
Whatever You Cut, A GIANT Will Solve Your Problem

LET US FIGURE IT OUT FOR YOU

TAYLOR, STILES & COMPANY, Riegelsville, N. J., U.S.A.

WATEROUS ENGINE WORKS
Brantford, Ont., Canada
Canadian Representatives

R. J. MARX
133 Finsbury Pavement, London E. C.
Sole Agents for Europe



"Toledo" Geared Pipe Cutters

These popular geared cutters comprise three models and have a capacity of 2½" to 12" inclusive. Fitted with knife cutters. Are portable. Can be split to encircle pipe already installed. Cuts off pipe quickly, leaving clean, square ends without burr. One man can operate any model with ratchet handle. Their greatest speed and efficiency can be gained by use of our Power Drive.

"Toledo" for Speed and Easy Operation

WHERE accurate, heavy duty pipe-cutting and threading must be done in a hurry—done easily and done conveniently—there are no pipe tools like "Toledos" to do the job.

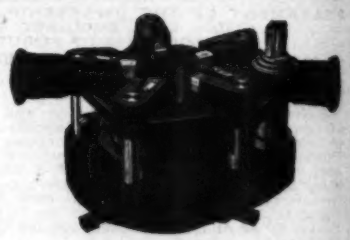
They offer everything a superintendent could possibly desire—portability, capacity, easy operation and durability.

Additions or replacements to your pipe tool equipment should not be made until you have investigated the "Toledo" line—the most complete line on the market today!

"Toledo" Power Drive

Attaches and detaches just the same and just as quickly as ratchet handle. Operates "Toledo" Threaders and Cutters ten times faster. Electric Driven. Can be wheeled anywhere and used wherever proper current is wired.

The Toledo Pipe Threading Machine Co.
TOLEDO, OHIO
New York Office: 50 Church Street, New York City



"Toledo" Geared Threading Devices

Four models comprise the "Toledo" line of geared Pipe Threading Devices. The combined capacity ranges from 2½" to 12" pipe inclusive. They are conceded by leading pipe fitting contractors to be the most efficient threading devices on the market today. One man can operate any model, including largest size. Are portable. Cut true, clean, accurate threads. Operated with ratchet handle or with "Toledo" Power Drive.

TOLEDO PIPE TOOLS

TRADE MARK REG.

THREADING DEVICES · POWER DRIVE · PIPE CUTTERS

New York, May 1, 1922.

THE paper market in and around New York and, according to authoritative reports ,all over the country—especially in the Middle West—has taken on a decidedly changed hue. On every side are indications of increasing trade activity, of a return of consumption of most kinds of paper to close to normal, of broader buying by consumers and jobbers, and of larger operations in manufacturing plants. Not in quite an interval have conditions seemed so favorable as at present, and certainly the situation is marked by a greater degree of activity than in a long time.

Figures concerning mill operations which have lately become available show conclusively how the industry is picking up and how manufacturers are finding a wider outlet prevailing for their product. The fine paper mills of the country are reported running at an average of 80 per cent of capacity, which, to say the least, marks considerable improvement when it is understood that at the same period of last year writing paper mills operated only around 30 per cent of full production. Newsprint mills are at present running at 85 per cent of capacity or better; some are producing at a maximum rate. Glassine and greaseproof paper plants are operating at around 75 per cent after failing to exceed 50 per cent in more than a year, while there has been relative expansion of operations in wrapping, tissue, roofing and other paper mills and in boxboard plants.

These figures, which come direct from manufacturers themselves, tell the story of the gratifying increase in demand for paper and indicate the favorable position of the industry. Only one branch of the industry continues quiet and that is book paper. Demand for this kind of paper has not increased along with that for other varieties of paper, and book paper mills are mostly in need of business. Few are running at or near capacity, and the keen competition that exists for such orders as are to be had makes for easiness in prices. Nevertheless, this branch of the trade is not without its redeeming features. There are numerous indications of a broader demand for book paper, and it would seem that it is only a matter of a short time when book paper manufacturers will find themselves with as much business as other producers of paper. For example, the recognized leading fiction weekly of the country recently added no less than 60 pages to a single issue, and one of the foremost trade periodicals put on 40 additional pages in a recent issue. These were not special issues but were regular issues, and the pages added were advertising and have since been continued. This is an illustration of how the consumption of book paper is on the rise, and it stands to reason that paper manufacturers will soon begin to feel the larger use of their product as soon as some of the stocks now held by publishers are used up.

The logic has been preached for some time past that as soon as business generally improved it would be instantly reflected in the paper industry. This is just what has happened. Industrial conditions the country over are better today than at any time since the period of after-the-war readjustment set in back in 1920. Many of the basic industries of the nation are experiencing more favorable conditions and are steadily increasing production because they are finding a broader market for their goods. The automobile, textile, clothing and rubber industries are notable examples. The public at large is once more digging into its pocket and bringing up money with which to buy the various necessities, as well as luxuries, which it requires. In other words, the country is getting back to a normal status as regards business, and a consensus of opinion is that American industry will experience even better than normal activity later this year—many look for business approaching a boom in the fall and early winter.

Newsprint is in a very active market position. There is a constant demand, which has been increased noticeably during the past several weeks since the danger of another strike of newsprint mill operatives loomed up. Publishers have been actively in the market and have bought up all the supply of paper found available so as to protect themselves in the event the strike is declared. At the moment it is difficult to say whether or not a strike will occur. Conferences were held in New York last week by paper manufacturers and union officials and a truce was declared for two weeks to enable the union leaders to again submit the proposals of the paper-mill owners to a vote of the workers. In the meantime mills are running very nearly at capacity and are moving out their product as quickly as it is ready for shipment. Consumption of newsprint is holding up remarkably well. Most newspapers, particularly those in the large cities which consume the great bulk of print paper, are printing larger issues than at this time a year ago, and also are circulating a greater number of copies of each issue. There is no shortage of newsprint, but at the same time mills are easily disposing of an output closely approximating full production, and matters are favorable for an increasing demand from publishers as imports from Europe gradually slide off.

The latest Federal Trade Commission report on the print paper industry shows that in March domestic mills produced 117,507 net tons of total newsprint—a gain of 20,000 tons over the 97,786 tons produced in the preceding month, and well above the 107,532 tons produced in March a year ago. Moreover, production in March was close to the 127,847 tons produced in March, 1920, when manufacturing operations in the paper industry were at an abnormal height. Despite the big jump in output last March, mill stocks increased only about 1,000 tons, which indicates that manufacturers found a ready outlet for practically all of their increased production during that month.

The market for fine papers is showing more life day by day. Consumers are buying in larger amounts, and jobbers once more are laying in stocks after having kept their shelves bare for a long time. Writing paper mills in New England and elsewhere through the country are running at an average of 80 per cent, with some exceeding this rate. Prices on bonds, linens and ledgers are firm and apparently fully stabilized. Manufacturers contend that the recent reduction in the price of bleached sulphite pulp will have no effect on fine paper quotations for the reason that prices on such paper were already lower than they should have been.

Wrappings are meeting with a fairly good demand, and this branch of the paper industry would be a great deal stronger were it not for imported supplies of wrapping which are being marketed in this country at relatively low prices. Comparatively large quantities of kraft wrapping are coming in from Sweden and every pound imported means just so much less business for domestic manufacturers, while the low prices quoted on the foreign product oblige domestic producers to keep their prices down in order to compete.

Tissues are moderately active and steady in price. There is an increasing demand for glassine and greaseproof papers, and cover papers are enjoying a broader market than in some time. Book papers are moving slowly and prices are easy. Most manufacturers are obliged to sell the bulk of their machine finished book paper at less than 6 cents a pound f.o.b. consuming points, and super book is bringing only in the neighborhood of 6 cents. The difficulty in this division of the industry is that there is not enough business to go around and manufacturers are cutting prices to land orders.

Boards of all descriptions are in good demand and quotations show an upward trend. Plain boxboards are moving in increasing amounts at prices ranging around $35 a ton for chip and $37.50 for filled news, and consumers are buying folding boxboards and boards for corrugating purposes in steady fashion.

Vapor Absorption System Increases Production

To increase the capacity of a board machine from 95 tons a day to 115 tons, simply by the addition of a vapor absorption system, is quite an accomplishment, but this is what was recently done, we are told, at one of the mills at Monroe, Mich. The board machine is 124 inches wide and was built by the Black-Clawson Company, Hamilton, Ohio, and the vapor absorption system was installed by the J. O. Ross Engineering Company, of New York.

The machine has 97 dryers, each 42 inches in diameter.

The installation of vapor absorption systems of board or paper machines seems to be a very profitable investment.

Wood Pulp

Many of our customers are now looking ahead and buying **KRAFT** and **SULPHITE** for first open water shipment, and for shipment later in the year. We have already booked a good-sized tonnage.

We will be pleased to figure on **YOUR** requirements.

We also have pulp available for prompt shipment from the docks in this country.

Scandinavian-American Trading Company
50 East 42nd Street
New York, N. Y.

E. J. KELLER COMPANY
INCORPORATED
200 FIFTH AVENUE
NEW YORK

FOREIGN AND DOMESTIC
PAPER MAKERS' SUPPLIES
CHEMICAL AND MECHANICAL PULPS
COTTON, JUTE AND FLAX WASTES
EAST INDIA MERCHANDISE

DANA T. McIVER

High Grade Printing Paper

116 So. Michigan Avenue
CHICAGO

BOOK AND COATED PAPER
Car Lot and Tonnage Contracts

ESTABLISHED 1895

Daniel M. Hicks

INCORPORATED

Foreign and Domestic **Rags, Bagging, Rope and Waste Paper, Pulps, Wires, Chemicals, etc.**

IMPORTERS —— *DEALERS*

200 Fifth Avenue, New York City

J. ANDERSEN & CO.

FREDERICK BERTUCH, SPECIAL PARTNER
21 East 40th Street, New York City

Importers of Chemical Pulps

BLEACHED AND UNBLEACHED

Agents for Kellner Partington Paper Pulp Co., Ltd. Sarpsborg, Norway; Forshaga, and Edsvalla, Sweden; Bergvik and Ala Nya Aktiebolag, Söderham, Sweden

Paper Stock

Now Is the Time to Buy Our Raw Materials

Out of the forty different kinds of paper stock graded in our many large warehouses, you are assured a steady, reliable source for procuring raw materials in practically every branch of paper making.

Having specialized for 35 years in this one field you can depend upon a clean, well-packed, uniform product throughout; fulfillment of delivery promises; and because of our output of 300 tons daily, big tonnage at all times.

Write us your wants and we'll gladly send further information.

Mendelson Bros. Paper Stock Co.
910 South Michigan Avenue, Chicago, Ill.
Long Distance Phones: Harrison 2840 and 5557.

Papermaking Rags

Despite the fact that demand from consuming quarters has not expanded to any important extent, papermaking rags show a firmer undertone. This seems due chiefly to the confidence of dealers and packers over the outlook, and also to prices being on levels where there is little room for additional decline. Moreover, during the past few days inquiry from paper mills has improved, and although actual buying continues noticeably limited, there are numerous signs that consumers are commencing to look to their forward requirements in rags and are sounding out the market with a view of getting a line on available stocks and the prices they will likely have to pay.

Probably not in a long time have rag dealers viewed the future with as much confidence as they now possess. This feeling of security regarding the outlook is due to several causes, chief of which is the belief that the boom in building all over the country must lead to an increased consumption of the low grades of rags through the heavier demand for roofing and building papers, and that the steadily improving position of the fine paper market will result in a larger consumption of the better grades of rags. Then, too, it is felt that with prices "beared" down to present levels, where there is scant inducement for collectors to gather rags, fewer rags have been collected recently, which should make for higher values when consumers resume buying on a broader scale.

Present indications are that there should be no scarcity of rags during the remainder of this year, but it appears quite probable that increased demand, if it develops—and there is every reason to believe that it will—will be accompanied by a rise in prices. On the other hand, should prices advance a reasonable amount there are reasons to expect that importations from Europe would jump considerably, thus probably preventing the market from touching any extreme heights. It is no secret that European dealers have fairly large stocks of rags which they are holding until a better market develops in the United States, and foreign supplies will likely keep rag prices from going beyond reasonable bounds.

Buying by paper mills in recent weeks has been principally of hand-to-mouth scope. Few consumers have shown willingness to absorb other than supplies actually and directly required, and the movement toward mills has not begun to approximate normal. However, there are numerous indications that a broader market is impending, and dealers with a few exceptions are pursuing a waiting policy in fond expectancy of a livelier demand and more attractive prices. Imports from Europe have dropped off considerably during the past several months, largely because prices worked down to levels where importers found it next to impossible to buy rags in Europe and sell them to paper mills in this country at a profit.

Prices exhibit a steadier tone than in some time, and it is becoming more difficult to purchase sizeable tonnage at the figures commonly recognized as representing market levels, as dealers demand premiums on large lots, particularly if for future delivery. Roofing rags of No. 1 grade are selling in the East at around 90 cents a hundred pounds f.o.b. dealers' shipping points and about one cent a pound in the West, while No. 2 packing is bringing 80 cents and 90 cents in the East and the West, respectively. Old No. 1 repacked whites are quoted at 4.75 to 5 cents per pound, No. 2 whites at 3 to 3.25 cents, repacked thirds and blues at 1.75 to 2 cents, black cotton stockings at 2 to 2.25 cents, and lace curtains at 3.25 to 3.50 cents. New No. 1 white shirt cuttings are bringing 10 to 10.25 cents a pound, washables 3.25 to 3.50 cents, new unbleached muslins 8.25 to 8.50 cents, white lawns 8 to 8.25 cents, and blue overall cuttings 4.75 to 5.25 cents.

Average quotations f.o.b. shipping points are:

New Stock—	New York and Chicago
White shirt cuttings, No. 1	10.00-10.25
White shirt cuttings, No. 2	5.00- 5.50
Fancy shirt cuttings	4.00- 4.50
Washables, No. 1	3.25- 3.50
Unbleached muslins	8.25- 8.50
White lawns	8.00- 8.25
Overall cuttings, blue	4.75- 5.25
Black silesias	3.00- 3.25
Light flannelettes	6.75- 7.25
Canton flannels, bleached	6.50- 7.00
Canton flannels, unbleached	5.75- 6.25
Shoe cuttings, bleached	5.75- 6.25
Shoe cuttings, unbleached	5.00- 5.50
Light silesias	5.00- 5.50
Linens, No. 1 white, foreign	13.50-14.50
Light prints, foreign	5.00- 5.50
Old Stock—	
Whites, No. 1 repacked	4.75- 5.00
Whites, No. 2 repacked	3.00- 3.25
Whites, house soiled	1.50- 1.75
Whites, street soiled	1.25- 1.50
Lace curtains	3.25- 3.50
Thirds and blues, rough	1.20- 1.40
Thirds and blues, repacked	1.75- 2.00
Black stockings	2.00- 2.25
Cotton canvas, No. 1	3.50- 3.75
White cotton batting	2.00- 2.25
Roofing, No. 1	.90- 1.00
Roofing, No. 2	.80- .90
Dark colored cottons, foreign	1.00- 1.10
Blue linens, foreign	3.25- 3.75
Grey linens, foreign	5.00- 5.50
White linens, foreign	9.00- 9.50
Light prints, foreign	1.90- 2.00

Rope and Bagging

Old rope and bagging are moving into consuming channels in a fairly regular manner in routine volume. Paper mills are buying conservatively, mostly confining their orders to supplies immediately needed, yet there is sufficient demand to sustain prices and the market tone is steady. Current supplies seem ample to fill buyers' wants although dealers place a good deal of emphasis on the small amounts of material coming forward from producing sources and say that any broadening of demand would probably effect higher prices. Importations of old rope from Europe are moderately large though nothing out of the ordinary, whereas but little bagging is coming in from foreign sources.

Quotations on old manila rope in No. 1 condition range around 4.25 cents per pound at dealers' shipping points for domestic rope, with imported rope selling down to 4 cents a pound ex dock New York and other American Atlantic ports. Mixed strings are in fairly steady demand at prices running from 85 to 95 cents a hundred pounds. Most sales of No. 1 scrap bagging are at about one cent a pound f.o.b. dealers' points though some tissue paper mills are paying up to 1.25 cents for specially graded and packed bagging. Gunny is in slack demand, and wool tares are meeting with but little call.

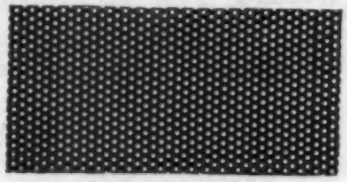
F. o. b. shipping point quotations follow:

	New York and Chicago
Gunny, No. 1 domestic	1.00-1.15
Gunny, No. 1 foreign	.90-1.10
Scrap bagging, No. 1	.90-1.00
Roofing bagging	.65- .75
Wool tares, heavy	1.40-1.60
Wool tares, light	1.20-1.40
Manila rope, No. 1 foreign	4.00-4.25
Manila rope No. 1 domestic	4.25-4.50
Sisal strings	1.40-1.60
Mixed strings	.85- .95

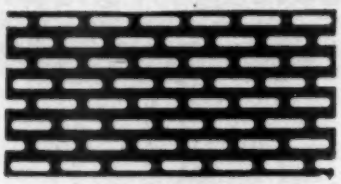
Old Papers

Quotations on many grades of old paper display a firming tendency and the market as a whole is in a livelier and steadier position. Despite the downtrend in prices on sulphite pulp, paper and board manufacturers in many cases continue to use old paper and are granting fairly high prices for the supplies wanted; in certain instances some kinds of old paper are bringing relatively better prices than wood pulp. One reason for this is that the production of waste paper of some descriptions is not up to normal and conse-

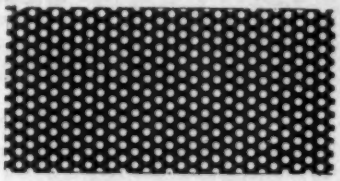
Perforated Metal Screens for Pulp and Paper Mills



.065 inch round



⅛ x ½" Slots



3/32 inch round

Steel, Copper, Brass, Bronze and other alloys punched for Centrifugal and Rotary Screens, Pulp Washers, Drainer Bottoms, Filter Plates, etc.

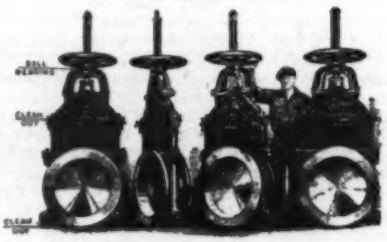
CHARLES MUNDT & SONS 57-65 Fairmount Avenue, Jersey City, N. J.

RECORD

(PATENTED)

QUICK OPENING GATE VALVES

Lever, Screw or Rack Operated



Furnished of Bronze, Acid Resisting Metals or Cast Iron

MANUFACTURED BY

RECORD FOUNDRY & MACHINE CO.

LIVERMORE FALLS, MAINE

KNOW WHAT YOUR COAL BILL SHOULD BE

There's no longer any such commodity as "Cheap Coal," and indications are that there probably never will be again. At present prices, or for that matter—at *any price*—it is neither good engineering practice nor good management to check your coal by mine weights or railroad weights.

RELIANCE WEIGHING MACHINES

insure an *accurate* and *positive* check on every ounce of coal consumed. They provide a means, without additional labor cost, of checking the total received against the total purchased. They show to operator and executive the exact amount of coal consumed by each boiler. They bring efficiency and economy into coal consumption.

Weighs—records—indicates—without manual effort—the entire operation automatic.

Each machine is a unit in itself, so perfect in design and flexible in application that it will meet any existing plant conditions.

The services of our engineers are at your command in helping you plan prospective installations.

Write us for details.

RELIANCE WEIGHING MACHINE CO.

General Offices and Factory

LUDINGTON, MICHIGAN

Representatives in principal cities United States and Canada

WE-FU-GO AND SCAIFE WATER

PURIFICATION SYSTEMS
SOFTENING & FILTRATION
FOR BOILER FEED AND
ALL INDUSTRIAL USES

WM. B. SCAIFE & SONS CO., PITTSBURGH, PA.

quently consumers are obliged to meet rather high prices to obtain required amounts. This is especially true as regards white shavings. Print shops the country over are not as busy as they ordinarily are and therefore fewer shavings are being cut, with the result competition is more or less keen for available supplies and prices hold up.

It is generally acknowledged that box board mills are operating at larger capacity than in some time, and this should make for a bigger demand for waste paper. However, board manufacturers are taking orders for their product at low prices—prices which net them a very small margin of profit—and consequently they are seeking to buy raw material in the form of old paper at as low prices as possible. There is little question that many of the low grades of old paper are selling at prices which give collectors and packers but slight profit, but it stands to reason that the situation as concerns the finished product into which the raw material enters must improve before much, if any, higher prices can be realized for waste paper.

Dealers and brokers are careful in booking orders involving large tonnage and also are reluctant to sell to mills for forward delivery very far into the future for the reason that they expect prices to advance quickly once demand assumes a little broader scope. Business at present therefore chiefly concerns waste paper that is collected one day, graded and baled the next day and sold to consuming mills the following day, with the average mill order involving a rather light tonnage. Quotations on soft white shavings of No. 1 quality range between 3.15 and 3.30 cents per pound at dealers' shipping points, and on No. 1 hard white shavings from 3.65 to 3.85 cents. Old magazines show a strengthening tendency, with most sellers asking at least 1.35 cents a pound at shipping points for No. 1 heavy book stock, and about 1.10 cents for No. 1 crumpled book. White news cuttings are firm at 1.65 to 1.75 cents a pound, and ledged stock holds steady at a quotable range of 1.60 to 1.80 cents, depending on the quality of packing. Folded news is quoted at 55 cents a hundred pounds in the East and a little higher in the West, while No. 1 mixed paper is bringing 45 to 55 cents a hundred pounds.

Prices f. o. b. shipping points are as follows:

	New York and Chicago
Hard white shavings, No. 1	3.65 -3.85
Hard white shavings, Nos. 2-3	2.75 -3.25
Soft white shavings	3.15 -3.30
Colored shavings	1.25 -1.50
Heavy book, No. 1	1.35 -1.50
Crumpled book, No. 1	1.05 -1.15
Ledger stock	1.60 -1.80
Kraft No. 1	1.65 -1.75
Manilas, No. 1	.90 -1.00
White blank news	1.65 -1.75
Overissue news, No. 1	.75 - .85
Folded news	.55 - .65
Mill wrappers	.65 - .75
Box board cuttings	.55 - .65
Mixed paper, No. 1	.45 - .55
Common paper	.30 - .40

Chemical Pulp

Probably the most important development in the domestic chemical wood pulp market recently is the reduction of a half a cent per pound in the price of bleached sulphite from 5 cents to 4.50 cents per pound f. o. b. pulp mills. This cut in prices was not altogether unexpected as many in the trade were of the opinion that the marketing of foreign bleached sulphite in this country at prices far below those named by domestic producers would oblige the latter to reduce prices to a point within closer proximity of the levels quoted by importers. It is expected that the lower price on domestic bleached sulphite will give rise to a better demand for this kind of pulp, especially since activity in the fine paper industry is on the increase, and late reports are to the effect that plants manufacturing bleached sulphite in both the United States and Canada are operating at a better rate of capacity than in some months.

The pulp market as a whole is characterized by no unusual trade activity. Buying is principally against direct requirements, and papermakers evidently cannot be prevailed on to cover forward needs. Nevertheless there is apparently enough demand prevalent to sustain prices on a fairly steady level. News grade sulphite is meeting with a moderately good sale at around 2.50 cents a pound at pulp mills, and No. 1 unbleached sulphite is quoted firmly at 2.75 to 3 cents. Kraft holds its own in price at from 2.75 cents upward for No. 1 quality pulp, although southern pine kraft is available at lower prices. Soda pulp is quiet and easy at a quotable range of 3.50 to 3.75 cents per pound at producing plants.

WHITAR
TRADE MARK REG. U.S. PAT. OFF.
News Blue
Auramine

We Supply a Complete Line of

Aniline *and* Pigment Colors

for Paper Makers

SPECIAL SHADES OF COLORED PAPER OR SAMPLES OF DYESTUFF MATCHED AND COMPLETE FORMULAS FURNISHED

The White Tar Aniline Corporation
56 Vesey Street, New York City
Works: Kearny, New Jersey

EASTWOOD Wire Mfg. Co.

Fourdrinier Wires
Cylinder and Washer Wires

Belleville, New Jersey
U. S. A.

WE ALSO MANUFACTURE

Valves, Unions, Cocks, Fittings, Digester Parts, Castings, etc., for Sulphite Mills from Our Perfection Bronze

LOCKPORT Felts

EXCLUSIVE MAKERS OF

Paper Makers' Felts

Have You Run Them?
If Not, Why Not?

Are You Interested in Accurate Running Felts?

Give Us a Trial
Get Authentic Information
Ask the Men Who Run Them

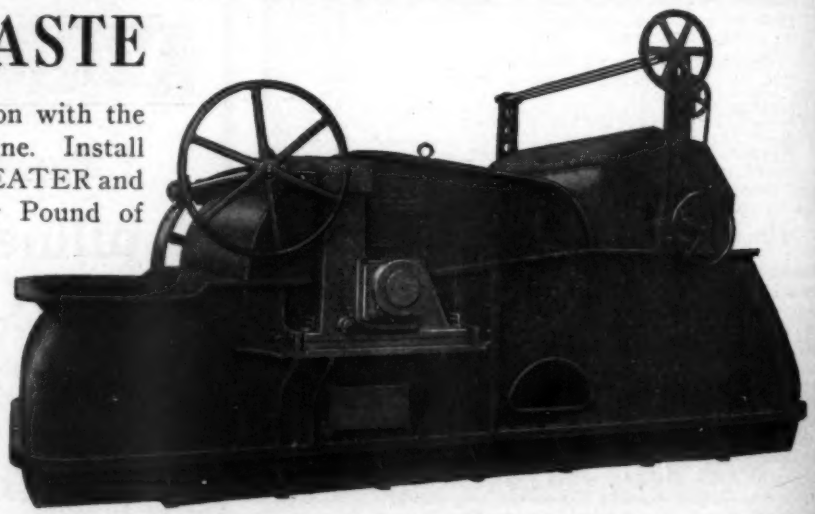
Yours for service

LOCKPORT FELT CO., Newfane, N. Y.

DON'T WASTE

Your Power by the Ton with the Ordinary Beating Engine. Install an UMPHERSTON BEATER and Save Power on Every Pound of Stock.

"We Build our Machinery to Meet Your Requirements"



IMPROVED TYPE OF UMPHERSTON BEATER

Information and Booklets describing our Specialties sent to you on request

HOLYOKE MACHINE COMPANY, Holyoke, Mass.

SOME OF THE "HOLYOKE" SPECIALTIES—Chilled Iron Rolls, Cotton Rolls, Paper Rolls, Wood Pulp Grinders, Wood Barkers, Wood Chippers, "Umpherston" Beaters, Rag and Paper Dusters, Washing and Beating Engines, Reeling Machines, Hydraulic Pumps, Hydraulic Presses, Coated Paper Strainers, Turbine Wheels, Gearing and Shafting, Calenders, Platers, Rag Cutters

F. o. b. pulp mill quotations follows:

Bleached sulphite	4.50-4.75
Easy bleaching sulphite	3.00-3.25
Unbleached sulphite, No. 1	2.75-3.00
News grade sulphite	2.40-2.65
Soda pulp, bleached	3.50-3.75
Mitscherlich, unbleached	3.25-3.50
Kraft, No. 1	2.75-3.00
Screenings, refined	.80-1.00

Mechanical Pulp

Notwithstanding that the production of mechanical wood pulp has undergone a considerable increase recently and that grinders probably have more pulp to sell than in some months, the tone of the market is fairly well stabilized and prices rule moderately steady. Plenty of water this spring has enabled grinders to operate their plants on a larger scale and production is probably in excess of the present consumption, yet grinders apparently are conserving the pulp for which they fail to find on outlet and no undue selling pressure is evident. Another sustaining factor is that newsprint mills are operating well, which removes the bulk of the supply of ground wood from the market, and board manufacturers also are absorbing substantial supplies regularly.

Instances are cited now and then where this or that producer, anxious to dispose of a tonnage of pulp, has sold ground wood at prices considered below market levels, but on the whole quotations are well maintained. Around $32 a ton f. o. b. grinding plants is an average of prices quoted by domestic producers, with figures $2 a ton on either side of this level named in some cases, depending on the distance the pulp has to be hauled to reach the consumer. Delivered consuming point quotations generally figure out between $37 and $40 per ton with very little variation, while Canadian ground wood brought down to New York in schooners is selling to mills in the East at $34 to $35 a ton f. o. b. New York.

Chemicals

Demand for papermaking chemicals continues to involve mainly small amounts needed by consumers for direct use, and most paper manufacturers are getting along with contract commitments in such a way as to preclude the necessity of entering the spot market excepting occasionally. Prices rule fairly steady nevertheless, with the tendency in most cases toward higher levels. Casein prices are stiffening and 10 cents a pound is the quotation commonly named. Caustic soda holds at about 3.50 cents a pound for spot delivery and a quarter of a cent less on contract, while soda ash is quoted at between 1.50 and 1.75 cents per pound. Brimstone is a trifle easier at $15 to $16 per long ton f. o. b. mines.

Quotations are as follows:

Alum, lump ammonia	3.65- 3.75
Alum, lump starch	4.00- 4.25
Blanc fixe, powdered	3.50- 3.75
Bleaching powder	1.75- 2.00
Brimstone (long ton, at mine)	15.00-16.00
Casein	9.50-10.50
Caustic soda, spot delivery	3.50- 3.75
China clay, domestic washed	8.00-10.00
China clay, foreign	13.00-18.00
Rosin, grade E	5.20-
Satin white	2.00- 2.25
Soda ash, 58 per cent light (bags)	1.50- 1.75
Sulphite of alumina, commercial grade	1.40- 1.60
Starch, papermakers', in bags	2.20- 2.30
Talc (ton)	10.00-12.00

Space at Boston Exposition Sells Rapidly

Most of the space in the main hall of the Boston Graphic Arts Exposition has already been sold and the space in the department devoted to exhibits of printing is fast being taken. The board of directors is now devoting more attention to publicity work, with the intention of assuring a large attendance of visitors at the show. Fifty thousand handsome half-sheet wall hangers are about to be mailed. Every printer in the United States and Canada is on the mailing list. The exhibits will be so versatile that the exposition will appeal to a large field. It is hoped to have a quarter of a million people pass the turnstiles between August 28 and September 2. It will be many years before another Graphic Arts show of such magnitude will be held.

Among the latest who have signed up for space in the exposition is the Whitaker Paper Company, Cincinnati, O.

The Dayton-Dowd Co., Quincy, Ill., has just issued bulletin 248, giving some interesting information about this company's line of centrifugal pumping machinery.

Western Paper Makers Chemical Company
Paper Makers Chemical Company
Kalamazoo, Mich. Holyoke, Mass. Easton, Pa.
Jacksonville, Fla. Pensacola, Fla. St. Austell, England

Rosin Size, Satin White, Clays, Fillers
Foam Killer, Felt Soap and Other Specialties

STANDARD BLEACHING POWDER
Manufactured by
Pennsylvania Salt M'f'g Co.
PHILADELPHIA, PA.

COLORS
Calender
Beating
Coating
S SANDOZ
For all grades of stock
PROMPT LABORATORY SERVICE
SANDOZ CHEMICAL WORKS
INCORPORATED
238-240 Water St., New York

OUR SOURCE OF SUPPLY IS
SANDOZ CHEMICAL WORKS
Basle, Switzerland

The
Hinde & Dauch Paper Co.

Corrugated
Fibre Shipping Boxes
and Packing Materials of
Acknowledged Superiority

Sales offices in principal cities

MAIN OFFICE
SANDUSKY, OHIO

EASTERN MANUFACTURING COMPANY

BLEACHED SULPHITE

Made from spruce grown in the forests of Northern Maine.

Send for Samples

EASTERN MANUFACTURING CO.
501 Fifth Avenue NEW YORK

New Sand Filter

A SPECIAL filter for paper mills, producing all the results the paper manufacturer desires. It is a modification of the well known Hungerford filter adapted to paper mill use. It is constructed of concrete, strictly wrought iron pipe, brass strainers and especially prepared silica sand. It is as durable and efficient as can be built at any cost. It can be sold at a very low figure.

This filter gives perfectly clear water, washes thoroughly, does not require renewal of the sand bed, is absolutely reliable in the performance of its duty and requires a minimum amount of attention.

Send for full particulars

Hungerford & Terry, Inc.
CLAYTON, N. J.

BATHURST LUMBER COMPANY, LIMITED

PRICE & PIERCE, LTD.
17 East 42nd Street, NEW YORK CITY

ARE NOW THE

SOLE SELLING AGENTS
for Bathurst Pulp

Unbleached Sulphite 50 tons daily
Kraft Pulp 50 tons daily

Our pulp is made from Canadian Spruce
We ship in sheets, baled

BATHURST, NEW BRUNSWICK, CANADA

New Papers

Writing—	
White rag	15-40
White sulphite, No. 1	10-20
Colored	12-40
Ledger—	
White rag	15-50
White sulphite	12-25
Colored sulphite	10-00
Colored rag	10-00
Bonds—	
White rag	13-40
White sulphite	9-20
Colored sulphite	10-25
Colored rag	14-40
Book—	
No. 1 S. & S. C.	6.00- 6.50
Machine finished	5.75- 6.25
English finished	5.75- 6.25
Coated and enameled	8.00-10.00
Lithograph, M. F.	9.50-12.00
Newsprint—	
Rolls, contract	3.50-
Rolls, transient	3.50-3.75
Sheets	4.00-4.25
Side runs	3.00-3.25
Cover Stock—	
Coated, both sides	9.25-
Coated, one side	9.20-
Tissue—	
No. 1 white, 20x30	.90-1.00
No. 2 white, 24x36	.75- .85
No. 1 manila, 24x36	.75- .85
Kraft	1.00-1.25
Wrappings	
No. 1 kraft	6.75-7.50
No. 2 kraft	5.75-6.50
Boards	New York and Chicago
Solid news	
Straw	45.00-50.00
Plain chip	35.00-40.00
White coated chip	55.00-60.00
Manila coated chip	52.50-57.50
Binders' board	70.00-80.00

Takes Issue with Editorial on Flood Situation

Because of the relation of the water power problem to the paper industry, Dr. Hugh P. Baker, Executive Secretary of the American Paper and Pulp Association, has taken issue with an editorial in the New York Evening Post, which discusses the flood situation in the lower Mississippi and other rivers. He says:

"Having spent some time in Germany and France in a study of forestry, and having gone over with a great deal of care the unusual work of the French Government in their stream correction work in Savoy in Eastern France, I am greatly surprised in one statement of the above mentioned editorial. In the last paragraph you state that 'Adequate reservoirs are impossible, and Government experts dismiss the idea that reforestation will help.' It would be very interesting to know what Government experts have dismissed the idea that reforestation will help the flood control, and also why you assume that adequate reservoirs are impossible and that the only method of correcting the flood situation on the lower reaches of our larger rivers are levees, bank revetments, and channel enlargements.

"Floods, like forest fires, occurred in this country no one knows how many times before this country was known to white man. We are going to continue to have some forest fires and some floods even with all that man can do to prevent these destructive agencies. That is, they will occur at intervals, sometimes years apart. Abnormal conditions such as the sudden breaking of Spring weather where there are unusual amounts of snow on the hills and mountains, at the headwaters of streams, with warm rains causing the unusual amounts of water to be precipitated into the streams to rush onto the low lands, carrying soil and debris that will be destructive to property of all kinds.

"Impounding flood waters, either at headwaters of streams or along their lower courses, will be exceedingly helpful in preventing floods. This idea of storage reservoirs is being used in the Pittsburg District, in the Miami Valley, and elsewhere in this country, with promise of great good. Long and thorough investigations in the older countries of Europe, however, have shown that storage reservoirs alone are not capable of insuring a stream against floods. Combined with storage reservoirs, a satisfactory forest cover on the hills and mountains on the headwaters of streams, will prevent floods.

"When Savoy, which is a mountainous province, was taken from Italy by Napoleon it was poorly handled for a number of years. France finally awoke to the fact that she was pretty nearly losing a province by failure to make the best use of the soil of the province, largely by allowing destruction of low lands by constant floods. She thereupon outlined a campaign, which in the end will mean the spending of millions of francs, used in the building of stone dams like steps up the narrow gorges, in the building of storage reservoirs, and finally, and in the minds of the French engineers, most important, the covering of the water sheds at the heads of streams with an evergreen forest. Not only in Savoy but elsewhere in the mountainous sections of France is this work being carried on. Switzerland began similar work years ago, and Germany and Austria, profiting by the experience of France, were doing the same work before the war. In every case it was considered that the building of levees, etc., were temporary expedients and that the solution of the problem lay in the combination of impounding reservoirs and reforestation.

"Competent engineers in this country who have looked into this matter, and who are now advising the Pittsburg Flood District, are not only recommending dams for the impounds of water but the complete covering of headwaters with continuous forests. The action of our Federal Government in spending large sums of money under the so-called Weeks Law for the purchase of forest lands at the headwaters of streams is a far sighted move which has already meant much in preventing floods among streams having their head in the Southern Appalachian Mountains. The flood situation in the Mississippi which, of course, is the greatest problem of its kind in the country, can be solved only with combination of impounding reservoirs and a very far sighted policy for the recovering of the watersheds at the headwaters of the Mississippi and Missouri with forests.

"It would be out of place here to attempt to describe the value of the forest in preventing rapid-run of water from melting snow, and from unusual downpour of rain. Suffice it to say that the forest cover breaks the force of rain, shades the snow so as to allow its gradual melting, lets the water work into the soil along the roots of the trees, to come out gradually in the springs and streams.

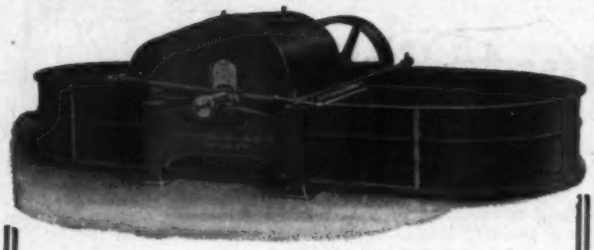
"This country has been so rich in her natural resources that she has been standing idly by for years and letting floods destroy great areas of fertile bottom lands, and now in many instances we are beginning at the wrong end of the problem by attempting to build up the banks of streams instead of going back to the headwaters where the problem can be solved."

Bird Machine Company Contributes to the Vocational Education Fund

One of the earliest contributors to the Vocational Education Fund was the Bird Machine Company, South Walpole, Mass. A letter received by the Vocational Education Committee last week carried an additional check, together with the following statement:

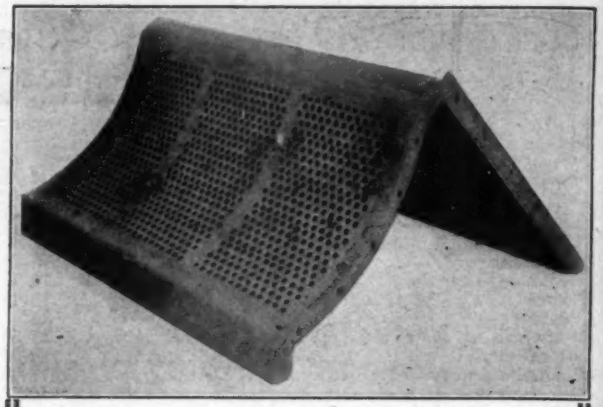
"Enclosed is our check for fifty dollars, which we send cheerfully, knowing that it will be well spent."

Co-operation of this kind is especially helpful to the committee in raising the necessary funds for the completion of the set of text-books, the first three volumes of which have already received favorable mention in every quarter.



"Dayton"
Beating Engines
are Built
for
Heavy Duty

Dayton Beater and Hoist Co.
DAYTON, OHIO



Because there are no moving parts this is a very simple but very efficient device. Patent No. 1,271,426 issued to Mr. Brownell Buehler, July 2nd, 1918.

The Shartle Continuous Beater Company
MIDDLETOWN, OHIO

A UNIVERSAL CHOICE *for* PAPER MILLS

EQUIPPED WITH FORGED STEEL FLANGES
LIGHT STRONG DURABLE

Steel fittings made for your individual requirements. Valves for pulp lines in stock at all times.

Production Book "A" Sent Upon Request

Our engineering department will help you solve your piping requirements

AMERICAN SPIRAL PIPE WORKS

MAIN OFFICE AND WORKS
P. O. BOX 485, CHICAGO

NEW YORK OFFICE
50 CHURCH STREET

Wood Pulp

As reported in the last issue of THE PAPER INDUSTRY would probably be the case, the Fordney tariff bill when reported out by the Senate Finance Committee carried a paragraph inserted by the members of that committee levying a 5 per cent ad valorem duty on imported chemical wood pulp. The bill now has to be passed by the Senate, and will then be returned to the House to be again passed on by the lower branch of Congress, and in the opinion of many members of the pulp trade the paragraph relating to wood pulp will be stricken out before the measure is finally enacted into law. There is no doubting that considerable pressure will be brought to bear on Congress to have wood pulp put back on the free list. Paper manufacturers of the country are opposed to a duty on pulp, and newspaper publishers also are against the placing of pulp on the dutiable list. Obviously, pulp importers are lined up against a pulp duty, but, as befits their position, they are keeping in the background and are permitting others who are not so closely concerned to lead the fight against the proposed duty. As a matter of fact, the 5 per cent duty imposed on chemical pulp means little or nothing in dollars and cents; neither will it serve to keep pulp supplies from foreign sources out of the United States. Therefore, it is but slight protection to domestic producers of pulp, and it is this line of argument that those who oppose the duty are bringing up to the Washington authorities. Further, it is contended that it is not fair to place a duty on pulp, which is the principal raw material for the making of paper, when most kinds of paper are permitted to come into the country free. Paper manufacturers in the United States are opposed to a pulp duty because they realize that imported pulp is a necessity in this country, and the rank and file of paper consumers are against the duty because they fear that it will make for higher prices on paper.

Importations of pulp into the United States continue at a fairly high level. The latest available Government figures show that in February a total of 66,443 net tons of chemical pulp was imported, which while considerably under the 95,637 tons imported in the preceding month, was far above the normal monthly tonnage brought into the country from outside sources. Before the war the trade was accustomed to figure average monthly imports in the neighborhood of 35,000 tons, which would mean that February imports were almost double the normal average. However, indications are that importers are finding an outlet for the great bulk of pulp being brought across the Atlantic from Scandinavia, Germany and Finland, and across the border from Canada, and one reason for this is that foreign wood pulp is being sold in the United States at relatively lower prices than domestic pulps. The heavy imports in recent months are all the more surprising because of the fact that ordinarily the first three or four months of the year comprise the period when shipments from Sweden to this market are at their lowest owing to the Baltic being closed to navigation. The conclusion reached is that producers abroad look to the United States as the main outlet for their pulp at present and are consequently shipping their product here to be sold at whatever prices can be obtained, although as Government investigation has proved, no dumping is being done.

Reports from Scandinavia are not of a very encouraging nature, telling as they do of production being materially curtailed because of the industrial strike in Sweden. Most of the Swedish pulp mills, the reports say, are not running better than 50 per cent, and raw material and weather conditions are said to be unfavorable. However, the quantities of pulp that are arriving in the U. S. from European sources would seem to counteract these reports.

Quotations on foreign pulps have changed but little, if any, recently. Bleached sulphite of No. 1 quality is selling at around 4.25 cents a pound ex dock New York and other American Atlantic ports, while No. 1 unbleached sulphite is quoted at an average of 2.75 cents per pound, easy bleaching sulphite at 3 cents, and Mitscherlich sulphite at 2.90 cents. Scandinavian kraft displays a little firmer tone due to the pulp manufacturers' association in Sweden having fixed a minimum price of about 2.65 a pound to American buyers. Some resale lots are being obtained by paper mills at slightly under this price level. Little ground wood is being imported from Europe for the reason that quotations at primary sources are too high to enable importers to compete with domestic and Canadian mechanical pulp.

Receipts at the port of New York in April and current market quotations follow:

Bleached sulphite, No. 1	$ 4.25-$ 4.50
Unbleached sulphite, No. 1	2.65- 2.90
Easy bleaching	3.00- 3.25
Mitscherlich unbleached	2.90- 3.00
Kraft	2.60- 2.85
Ground wool, per ton	35.00-

Castle, Gottheil & Overton, 1,000 bls. from Hamburg, 1,765 bls. from Bremen and 874 bls. from Rotterdam; Guaranty Trust Co., 467 bls. from Gothenburg; J. Anderson & Co., 500 bls. from Gothenburg and 600 bls. from Christiania; Scandinavian-American Trading Co., 6,048 bls. from Gothenburg and 2,653 bls. from Stockholm; M. Gottesman & Co., 1,500 bls. from Gothenburg; A. J. Pagel & Co., 7,000 bls. from Gothenburg and 2,922 bls. from Stockholm; the Borregaard Co., 3,475 bls. from Gothenburg; C. L. Robinson, 3,250 bls. from Gothenburg; E. M. Sergeant & Co., 1,750 bls. from Gothenburg and 700 bls. from Hamburg; American Woodpulp Corp., 1,950 bls. from Hamburg and 541 bls. from Rotterdam; Fred Enders & Co., 9,853 bls. from Stockholm; H. Holleson, 5,900 bls. from Bremen and 4,150 bls. from Hamburg; Irving National Bank, 4,355 bls. from Hango; Lagerloef Trading Co., 610 bls. from Hango; Kidder, Peabody & Co., 2,400 bls. from Christiania; Johaneson & Co., 1,300 bls. from Gothenburg; Mechanics & Metals National Bank, 1,000 bls. from Fredrikstad; Whalen Pulp and Paper Co., 16,330 bls. from Vancouver, B. C.; Tidewater Paper Mills Co., 22,763 bls. ground wood from Liverpool, N. S.; Order, 1,200 bls. from Hamburg, 1,086 bls. from Bremen and 500 bls. from Christiania.

Paper Stock

Importations of papermaking materials continue at a rather low level. Arrivals during the month of April, judging from the receipts through the port of New York, probably were of smaller tonnage than in any month for a year or more, and importers assert that the slackening of shipments from European sources to this market is nothing else than a reflection of the light demand from American paper mills and the low prices obtaining on such goods in this country. European merchants in a majority of cases are said to be unwilling to sell their rags, rope, bagging and other paper stock at prevailing prices and are holding supplies in expectation of a better market in the United States later on. There were few sizeable shipments of rags to reach New York during April, and receipts of old rope and bagging were also below those of the several preceding months. Arrivals through the port of New York in April follow:

Old Rope

Brown Bros. & Co., 426 coils from Havre, 407 coils from Bristol and 593 coils from Newcastle; E. J. Keller Co., 79 coils from Rotterdam; J. Perlman, 10 bls. from Havana; Katzenstein & Keene, 48 coils from Rotterdam; First National Bank of Boston, 107 coils from Genoa and 175 coils from Rotterdam; Gray Bros., 10 bls. from Bristol; Daniel M. Hicks, Inc., 95 coils from Leith; N. E. Berzen, 3 bls. from Hamburg; Cleveland-Akron Bag Co., 153 coils from Glasgow and 62 coils from Bristol; Niebrugge & Day, 98 bls. from Hamburg; Order, 136 coils from London.

Old Bagging

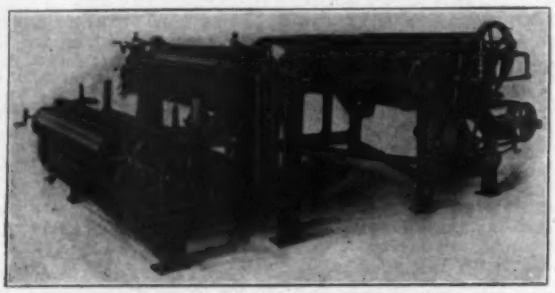
E. J. Keller Co., 156 bls. from Rotterdam, 308 bls. from Manchester and 106 bls. from Hamburg; Bank of Montreal, 181 bls. from Manchester; American Exchange National Bank, 66 bls. from Manchester; Order, 10 bls. from Liverpool.

Rags

F. P. Gaskell & Co., 177 bls. from Bremen and 126 bls. from Hamburg; Mechanics & Metals National Bank, 66 bls. from Hull and 37 bls. from London; Albion Trading Co., 20 bls.

Wax Paper Coating Machines

Carbon Paper Coating Machines
Gumming and Gluing Machines



Type 40-G. Semi and Full Wax Coating Machine.
Patented in United States. Also in Great Britain, Canada and Germany.

This machine will coat one or both sides of the paper with the exact amount of wax desired; with finest high gloss finish on self-sealing bread wrappers, also on both heavy or light papers; it can absorb the wax entirely into the paper or retain most on the outside; also high grade dry waxed paper, and best grades of waterproof and oiled papers up to 72 inches wide, at a fast rate of speed. For light tissue waxing, use our Type 45-C.

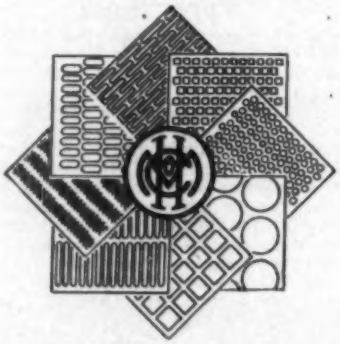
Write for particulars of machines in which you are interested. Submit your problems to our Engineering Dept. A.

MAYER COATING MACHINES CO.
Rochester, N. Y., U. S. A.
CABLE ADDRESS—CARMATIC

Stickle Compound Condensing System
and Automatic Steam Control
for Paper Machines

As shown in the folder we sent out to the mills—"*How to Dry Paper*"—showing our Compound Condensing System for draining the dryers and heating the air with the discharge from the dryers to condition the machine room should interest you. We guarantee a saving of 20 per cent in steam consumed for this purpose.

Open Coil Heater & Purifier Company
Indianapolis Indiana
Boston Philadelphia



Perforated Metal Screens

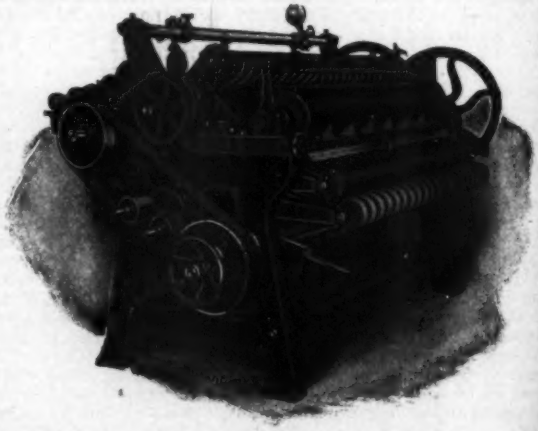
in all metals for pulp and paper mills
Elevator Buckets (Plain and Perforated)
Conveyor Flights and Trough
General Sheet and Light Structural Work
Light and Heavy Steel Plate Construction
Write for perforated metal handbook

Hendrick Mfg. Company

Main Office & Works
Dundaff Street
Carbondale, Penna.

30 Church Street
New York City

544 Union Arcade Building
Pittsburgh, Penna.



PAPER CUTTERS

Single, Duplex, and Diagonal

CUTTER KNIVES
PATENT TOP SLITTERS

Hamblet Machine Co.
LAWRENCE, MASS.

from London and 31 bls. from Bordeaux; Brown Bros. & Co., 58 bls. from London; Goldman, Sachs & Co., 154 bls. from Havre; L. L. Brown Paper Co., 71 bls. from Leith; J. M. Jaffe, 36 bls. from Rotterdam; W. Hughes & Co., 251 bls. from Rotterdam; R. F. Downing & Co., 428 bls. from Rotterdam; E. J. Keller Co., 274 bls. from Rotterdam and 786 bls. from Hamburg; American Express Co., 273 bls. from Bristol and 462 bls. from Cardiff; Castle, Gottheil & Overton, 343 bls. from Havre, 43 bls. from Bordeaux, 259 bls. from Rotterdam and 2 bls. from Antwerp; American Woodpulp Corp., 32 bls. from Hamburg; Irving National Bank, 116 bls. from Hamburg; National City Bank, 61 bls. from Hamburg; Chase National Bank, 27 bls. from Hamburg; Order, 21 bls. from London, 273 bls. from Havre and 381 bls. from Bordeaux.

Miscellaneous Paper Stock

George A. Graves & Co., 85 bls. from Glasgow; Ladenburg, Thalman & Co., 16 bls. from Hamburg; Furness, Withy & Co., 47 bls. from Glasgow; Maurice O'Meare Co., 25 bls. from Belfast; Irving National Bank, 42 bls. from Antwerp; E. J. Keller Co., 17 bls. from Havre; S. Silberman Co., 46 bls. from Rotterdam; Order, 46 bls. from Liverpool.

Paper

Importations of kraft wrapping from Sweden and Germany continue to feature the imported paper market. Large shipments of wrapping papers reached the United States in April, probably as great a total being received last month as in March when the sharp increase in wrapping paper imports first became so noticeable. Importers are reported having little or no difficulty in finding ready buyers for this paper, which is being marketed in this country at prices slightly under those quoted by domestic manufacturers.

Imports of newsprint keep up at a fairly high level. There is not the tonnage now coming in that was received in some months of last year, nevertheless present receipts are considerably above normal. Some fair-sized amounts of hanging paper were received, mostly from England, in April, and cigarette paper imports were about as usual in volume. Arrivals at the port of New York during April follow:

Cigarette

American Tobacco Co., 139 cs. from Havre, 47 cs. from Liverpool and 200 cs. from Bordeaux; Rose & Frank Co., 155 cs. from Havre; British-American Tobacco Co., 82 cs. from Liverpool and 37 cs. from Southampton; Equitable Trust Co., 96 cs. from Havre; H. Reeve Angell & Co., 9 cs. from Hango; P. J. Schweitzer, 13 cs. from Marseilles; Gluckmann & Stranchi, 8 cs. from Havre; Liggett & Myers Tobacco Co., 8 cs. from Bordeaux.

Printing

C. K. MacAlpine, 1,745 rolls from Gothenburg; Maurice O'Meara Co., 730 rolls from Gothenburg and 9 bls. from Antwerp; Atlantic National Bank, 380 rolls from Gothenburg; C. Sheiner, 5 cs. from Hamburg; Globe Shipping Co., 10 cs. from Havre, 101 cs. from Bremen and 59 cs. from Rotterdam; Oxford University Press, 6 cs. from Liverpool and 6 cs. from Southampton; P. C. Zuhlke, 125 cs. from Antwerp; H. Reeve Angell & Co., 368 rolls from Bremen and 187 rolls from Hango; Chemical National Bank, 219 rolls from Bremen and 866 rolls from Hamburg; Agar Bernson Corp., 488 rolls from Hamburg; United States Lines, 7 rolls from Bremen; Overseas Importing Co., 45 rolls from Hamburg; Superior Card & Paper Co., 62 rolls from Hamburg; Agros Corp., 109 rolls from Hamburg; Central Card & Paper Co., 135 bls. from Hamburg; B. F. Drakenfeld & Co., 90 cs. from Liverpool; First Federal Foreign Banking Assn., 96 rolls from Hamburg; F. G. Prager & Co., 34 cs. from Hamburg; Allied Forwarding and Shipping Co., 98 rolls from Hamburg; Chase National Bank, 1,249 rolls from Norrkoping, and 3,473 rolls from Hallstavik; W. F. Etherington & Co., 44 cs. from Glasgow; F. A. Munsey & Co., 409 rolls from Hango; Virginia Paper Co., 224 rolls from Hango; White-Burbank Paper Co., 3 cs. from Glasgow; C. B. Hewitt & Bros., 104 rolls from Hango; Irving National Bank, 378 rolls from Hango and 986 rolls from Bremen; New York Tribune, 190 rolls from Hango; Pulp and Paper Trading Co., 305 rolls from Hango; Haring Paper Corp., 530 rolls from Brevik; Gerhard & Hey, 25 cs. from Hamburg; Philadelphia National Bank, 20 cs. from Hamburg; Equitable Trust Co., 45 rolls from Hamburg; Order, 2,113 rolls from Hango, 19 cs. from London, 12 rolls from Bremen, 42 bls. from Antwerp, 219 rolls from Hamburg and 489 rolls from Copenhagen.

Wrapping

D. S. Walton & Co., 4,787 rolls and 151 bls. from Gothenburg; Republic Bag and Paper Co., 2,398 rolls from Bremen;

HANS LAGERLOEF, President and Treasurer
ORVAR HYLIN, Vice President
MAURICE LONDON, Secretary

TRADE HL MARK
REGISTERED

Lagerloef Trading Co., Inc.

52 Vanderbilt Avenue
NEW YORK, N. Y.

Telephones
Murray Hill { 4246 4247

WOOD PULP

SOLE AGENTS IN U. S. A., CANADA, MEXICO AND CUBA FOR

Finnish Cellulose Association
Helsingfors, Finland

AND

Finnish Wood Pulp Union
Helsingfors, Finland

A. D. COOK, Inc.

Lawrenceburg **Indiana**

FIG. NO. 59

Manufacturers of Deep Well Pumps, Working Barrels, Rods, Foot Valves, Strainers and a full line of Water Well Supplies.

The accompanying half tone shows the COOK Patent Brass Tube Well Strainer with Standard Fittings, which are Bail Plug in the bottom and Foot of Blank and Lead Packer on top.

When the COOK Strainer is properly selected for the water bearing sand, capacity and method of pumping, it will successfully deliver the maximum yield of the well for many years free from sand and the troubles incident thereto.

Write for Bulletin 30A

BACK TO NORMALCY

Owing to substantial reductions in the cost of all materials entering into the construction of Jenssen Acid Towers, we are now building them at

NORMAL PRICES

Will YOU let us show YOU how to make MONEY by making a

BETTER ACID

Don't forget that every second sulphite mill on this continent is using our towers, so ask your neighbor what HE thinks of them.

G. D. JENSSEN CO.

200 5TH AVE. NEW YORK, N. Y.

Guaranteed Perfect

Draper Hollow Balanced Brass Balls

FOR STUFF PUMPS

Absolutely balanced; will not pound out of shape

Specify these when ordering new pumps.

Order these to replace worn-out balls.

We make a specialty of repairing stuff pump balls.

We also manufacture—

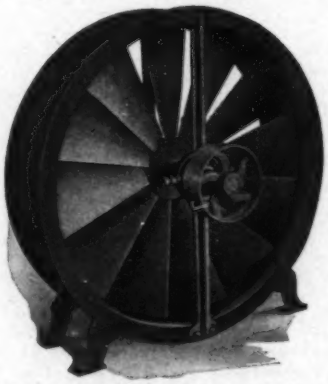
SOLID BRASS BALLS
IRON AND STEEL BALLS
BALL CHECK VALVES
VALVE FACING TOOLS

The Draper Manufacturing Co.

Port Huron, Mich. **Petrolea, Canada**

Every ball bears our registered trade-mark

Ventilating Fans



The Knowlton Multiblade Fans are the best that can be obtained for paper mill ventilating because they are exceedingly rugged—perfectly balanced and the air capacity is exceptionally large.

Sizes in Stock 32 inch, 40 inch, 48 inch
Any other size built to order
Either Belt or direct connected Motor Drive

WRITE FOR CIRCULAR

May we have your inquiries for Special Machinery —Iron Castings—Table and Wire Rolls—Cut Gears —etc., etc.

KNOWLTON MACHINE CO.

Established 1864

WESTBROOK **MAINE**

Atlantic National Bank, 769 bls. from Hamburg; Maurice O'Meara Co., 157 rolls from Gothenburg; Diem & Wing Paper Co., 8 rolls from Gothenburg; Arkell Safety Bag Co., 462 rolls from Gothenburg; F. S. Strype, 20 bls. from Gothenburg; Coy, Hunt & Co., 39 rolls from Gothenburg; M. M. Cohen, 389 rolls and 134 bls. from Gothenburg; Triple Commercial Co., 52 bls. from Hamburg; Kronfeld, Saunders & Co., 14 rolls from Hamburg; Chemical National Bank, 416 rolls from Trondhjem; Merchants National Bank of Rochester, 169 rolls from Fredrikstad; International Acceptance Bank, 164 rolls from Christiania, and 1,226 rolls and 367 bls. from Trondhjem; Irving National Bank 1,980 rolls from Christiania and 462 rolls from Fredrikstad; A. Bleyer & Co., 1,845 rolls from Hango; J. B. Harris & Co., 50 bls. and 57 rolls from Hango; C. F. Hubbs & Co., 95 rolls from Gothenburg; Ladenburg, Thalman & Co., 720 rolls and 254 bls. from Hamburg; Wilkinson Bros. & Co., 436 bls. and 239 rolls from Rotterdam, 453 bls. from Hamburg, and 238 rolls and 29 bls. from Copenhagen; Order, 19 bls. from Hango and 61 cs. from Hamburg.

Hanging

A. Murphy & Co., 6 bls. from Havre, 17 bls. from Liverpool, 56 cs. from Hamburg and 12 bls. from London; W. H. S. Lloyd & Co., 65 bls. from London and 5 bls. from Liverpool; A. C. Dodman, 13 bls. from Liverpool; A. Frankan & Co., 9 cs. from Hamburg; W. Larzelere & Co., 1,198 rolls from Antwerp; F. G. Prager & Co., 536 bls. from Bremen and 2,877 rolls from Antwerp; J. W. Hampton, Jr., & Co., 40 cs. from Hamburg and 2 cs. from Havre; Bernard, Judae & Co., 2 cs. from Havre; Manufacturers' Union, Inc., 4 cs. from Hamburg; Judson Freight Forwarding Co., 9 cs. from Havre; F. A. Binder, 236 bls. from Bremen and 5 bls. from Hamburg; M. G. Lange & Co., 11 cs. from Hamburg; R. F. Downing & Co., 21 cs. from Yokohama; H. O. Wagner, 3 rolls from Hamburg; Irving National Bank, 33 cs. from Hamburg; Order 5, bls. from London and 24 cs. from Antwerp.

Writing

Defiance Mfg. Co., 6 cs. from Marseilles; Judson Freight Forwarding Co., 4 cs. from Havre; R. G. Auspitzer, 4 cs. from Hamburg; Steiner Paper Corp., 17 cs. from Hamburg; J. W. Hampton, Jr., & Co., 11 cs. from Hamburg.

Drawing

E. Dietzgen & Co., 19 cs. from Havre and 21 cs. from Hamburg; Favor, Ruhl & Co., 23 cs. from London; Lunham & Moore, 31 cs. from Rotterdam; G. W. McIver & Co., 2 cs. from Bremen; Keuffel & Esser Co., 38 cs. and 201 rolls from Hamburg; Order, 2 cs. from Liverpool and 10 cs. from Hamburg.

Filter

Lunham & Moore, 6 cs. from Rotterdam; E. H. Danziger & Co., 4 cs. from Hamburg; Eimer & Amend, 3 cs. from Rotterdam; Bernard, Judae & Co., 4 cs. from Gothenburg; E. Fougera & Co., 54 cs. from Southampton; G. Euler, 30 bls. from Bordeaux.

Tissue

Graham Paper Co., 3 cs. from Liverpool; Meadows, Wye & Co., 5 cs. from Liverpool; R. Hoe & Co., 1 cs. from London.

Photo

J. J. Gavin & Co., 3 bls. from Liverpool; Geváert Photo Co., 55 cs. from Antwerp; G. Gennert, 10 cs. from Bremen; Eastman Kodak Co., 37 rolls from Rotterdam.

Boards

Metropolitan Importing & Mfg. Co., 117 cs. from Hamburg; Phoenix Shipping Co., 20 cs. from Hamburg; Lewis & Co., 3 cs. from Hamburg; Bernard, Judae & Co., 2 cs. from Hamburg; Knauth, Nachod & Kuhne, 32 cs. from Bremen; Gerhard & Hey, 4 cs. from Bremen; International Forwarding Co., 9 cs. from Hamburg; Fibre Case & Novelty Co., 90 bls. from Gothenburg; Hensel, Bruckmann & Lorbacher, 30 cs. from Hamburg; W. B. Wheeler Corp., 100 cs. from Bremen; A. H. Ringk & Co., 5 cs. from Bremen; New York Importing Co., 33 cs. from Hamburg; Order, 2 cs. from Hamburg and 9 cs. from Antwerp.

Miscellaneous

Brown Bros. & Co., 49 bls. from Gothenburg; P. Garvan, 27 bls. from Gothen; W. S. Force & Co., 11 cs. from Hamburg; Berger & Wirth, 7 cs. from Hamburg; Judson Freight Forwarding Co., 9 cs. from Havre; Kern Commercial Corp., 61 cs. from Rotterdam; Gallagher & Ascher, 12 cs. from Hamburg; Meadows, Wye & Co., 3 cs. from Hamburg; Chase National Bank, 2 cs. from Bremen; Phoenix Shipping Co., 5 cs. from Hamburg; Birn & Wachenheim, 47 cs. from Havre;

Rebuilt Paper Mill Machinery in Stock and Guaranteed

Not Where Is and As Is

FOURDRINIER TISSUE MACHINE—One 96", one 68".
FOURDRINIER PARTS—Pusey & Jones 118", 100". Kutter Trowbridge 96".
PRESS PARTS FOR PAPER MACHINES—Pusey & Jones bell crank housing two sets 18"x96", Black & Clawson swing arm housings with rolls.
DRYERS—Four 48"x111", thirteen 36"x95", four 48"x68", one 84"x67", eleven 42"x66".
MARSHALL DRIVES—Two Black & Clawson self-contained stand with friction clutch cone pulley and 6" mortise gears. Mortise gears and pinions for Pusey & Jones Marshall drives 5" to 8" face.
CHILLED CALENDERS—One 66" face, five roll, one 54" face, five roll.
DILLON DOCTORS—For Machine Calenders 60" to 120" face.
SLITTERS AND WINDERS—One 120" Warren, one 108", 36" Kidders.
REELS—Pusey & Jones two drum upright 48" to 114".
BEATERS—Five 72"x42" Noble & Wood, one 66"x42" Noble & Wood, equipped with three cylinder washers; one Dilts 62"x50" iron tub, one Jones 62"x52", seven Horne 36"x36". Two No. 2 Claflins, two No. 1 Claflins.
JORDANS—One Wagg Majestic, three No. 2 Dillon Improved, one large Horne, four Monarch, one Jones Standard, two Pope Brushing engines.
SCREENS—Six 10 plate open side Packer, two 6 plate, one Moore & White auxiliary.
STUFF PUMPS—Deane triplex 9"x8", Gould triplex 8"x10", Sandusky triplex 4"x6".
REVOLVING SHEET CUTTERS—One 104" Horne, five 61" Hamblet, four 61" Finlay, one 50" Hamblet diagonal, one 42" Finlay.
WET MACHINES—Four 72" Bagley & Sewall Hydraulic.
SUPER CALENDERS—One 45", one 42", one 36" Holyoke.

We have a large number of pumps and over five hundred calender, press and couch rolls in stock.

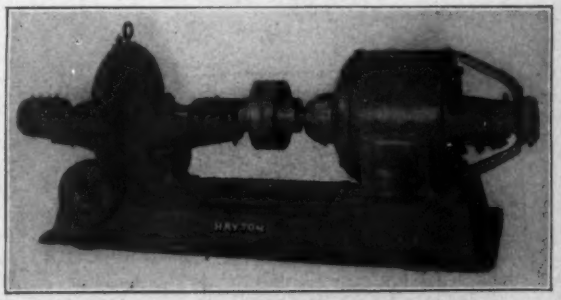
Frank H. Davis Company

175 Richdale Avenue, Cambridge, 40, Mass.

Hayton Centrifugal Pumps

SAVE POWER and MONEY

BY USING



HAYTON CENTRIFUGAL PUMPS

"With us it is an engineering problem"

Designed especially to meet the requirements of pulp and paper mills. We do not build a pump after OUR ideas and then try to sell it to you. We make a study of YOUR peculiar problems, and then build a pump to suit your needs. Hayton Pumps are built for hard, continuous operation, and will stand up under the most severe usage. We guarantee the highest efficiency, and maximum economy in power consumption.

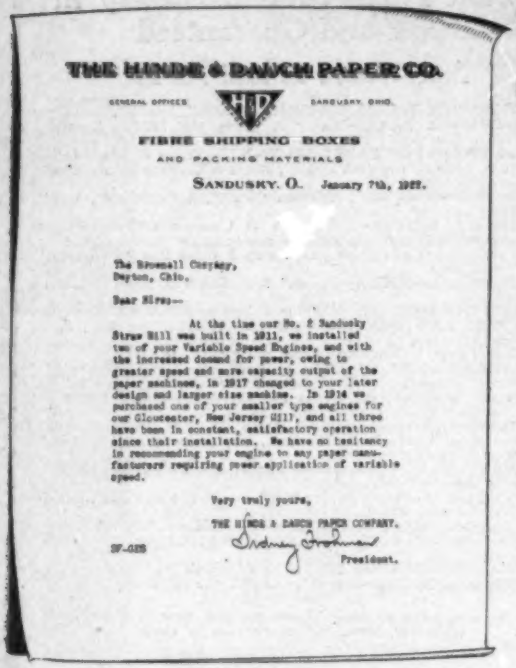
We also build a full line of Sandusky Triplex pumps.

Let us have your specifications for quotations

Hayton Pump & Blower Co.

Manufacturers

APPLETON, WISCONSIN



THE HINDE & DAUCH PAPER CO.

GENERAL OFFICES SANDUSKY, OHIO.

FIBRE SHIPPING BOXES
AND PACKING MATERIALS

SANDUSKY, O. January 7th, 1922.

The Brownell Company,
Dayton, Ohio.

Dear Sirs:--

At the time our No. 2 Sandusky Straw Mill was built in 1911, we installed two of your Variable Speed Engines, and with the increased demand for power, owing to greater speed and more capacity output of the paper machines, in 1917 changed to your later design and larger size machine. In 1914 we purchased one of your smaller type engines for our Gloucester, New Jersey Mill, and all three have been in constant, satisfactory operation since their installation. We have no hesitancy in recommending your engine to any paper manufacturers requiring power application of variable speed.

Very truly yours,

THE HINDE & DAUCH PAPER COMPANY.

SF-GJS President.

BROWNELL

The experience of The Hinde & Dauch Paper Company with three Brownell Variable Speed Engines is typical of many large paper making organizations.

Brownell is the pioneer in the development of variable speed engines for paper mills and has consistently led the way in improving these highly specialized machines.

There are a number of important and exclusive features in Brownell construction that you should be familiar with. If you are not, let us send you Bulletin E-4.

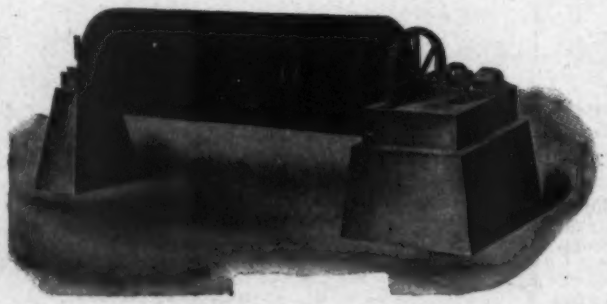
Sales Representatives in nearly all large cities

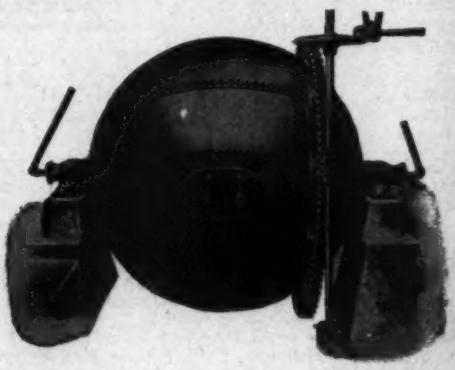
The Brownell Co., Dayton, Ohio
Established 1855

VARIABLE SPEED ENGINES

BIGGS

Globe and Cylinder Rotary Bleaching Boilers





Biggs Rotaries have been adopted as standard equipment since 1887. Let us figure on your next installation.

We specialize in Steel Storage and Pressure Tanks, and general steel plate construction for the paper trade.

The Biggs Boiler Works Company

Seneca Place and Case Ave. AKRON, OHIO

VAULT